



CH2M HILL  
1748 West Truck Road  
Otis ANGB, MA 02542

29 March 2013

Mr. Jonathan S. Davis  
Remediation Program Manager  
HQ AFCEC/MMR  
322 E. Inner Road  
Otis ANG Base, MA 02542-5028

SUBJECT: AFCEC 4P FA8903-08-D-8769; Task Order 0337  
MMR SPEIM/LTM/O&M Program  
CDRL #A001j  
**Fuel Spill-1 2012 Summary Letter Report**

Dear Mr. Davis:

The purpose of this Summary Letter Report (SLR) is to document the results of sampling activities conducted at the Fuel Spill-1 (FS-1) plume under the System Performance and Ecological Impact Monitoring (SPEIM) program during the 2012 calendar year. This deliverable contains no detailed assessment or evaluation of the results, but is a means of documenting all the actions completed under the FS-1 SPEIM program. The data collected under the SPEIM program are continually assessed and the results of these assessments are presented initially during the Technical Update Meetings and then through Technical Memoranda or Project Note deliverables, if warranted, based on the results of the data evaluation or to address particular plume issues.

In October 2012, the Air Force Center for Engineering and the Environment (AFCEE) adopted a new organizational name, the Air Force Civil Engineer Center (AFCEC). Therefore, the AFCEE and AFCEC acronyms refer to the same entity, but are used in this document in relation to the date of a specific topic or document.

This letter report includes a summary of the activities performed and the data collected for the FS-1 SPEIM program between 01 January 2012 and 31 December 2012. The FS-1 plume is defined as the extent of groundwater contaminated with the FS-1 plume contaminant of concern (COC), ethylene dibromide (EDB), at concentrations exceeding the Massachusetts Maximum Contaminant Level (MMCL) of 0.02 micrograms per liter ( $\mu\text{g/L}$ ). Lead, thallium, and toluene are COCs for the FS-1 source area groundwater (AFCEE 2000). Lead continues to be monitored through biennial sampling of source area monitoring wells. However, the source area groundwater is no longer monitored for toluene and thallium because toluene has not been detected at concentrations above the Maximum Contaminant Level of 1,000  $\mu\text{g/L}$  since 1999 and thallium was not detected at source area groundwater monitoring wells during 12 sampling events completed between 2002 and 2005 (AFCEE 2005).

AFCEE installed the FS-1 extraction, treatment, and discharge (ETD) system as a pilot test, which operated between 05 April 1999 and 13 October 2002, when a fire destroyed the treatment plant. The pilot ETD system was located in the southern portion of the plume and consisted of one extraction well (36EW0005) and 175 shallow wellpoints (SWPs) that operated at a combined extraction rate of 750 gallons per minute (gpm). The final remedy for the FS-1 plume was identified in the Final Record of Decision (ROD) as continued operation of an ETD system (AFCEE 2000). Based on plume characterization and groundwater modeling completed subsequent to issuance of the ROD, the final ETD system was designed as described in the final wellfield design report (AFCEE 2001). A Final Explanation of Significant Differences was submitted in September 2011 that clarified the inclusion of monitored natural attenuation as a component of the selected remedy, slightly modified the phrasing of the remedial action objectives, added the well verification process associated with the Land Use Control (LUC) Program, and updated the steps to achieve site closure (i.e., the three-step process) (AFCEE 2011).

The final ETD system began operating on 30 September 2003 (AFCEE 2005). It was designed to extract and treat groundwater at a rate up to 750 gpm using four extraction wells (36EW0001, 36EW0005, 36EW0007, and 36EW0011) located in the south-central portion of the plume. The FS-1 plume and treatment system are presented in [Figure 1](#). The southernmost extraction well (36EW0001) replaced the SWP system, which was decommissioned in November 2003 (AFCEE 2005). The extracted groundwater is conveyed to the treatment plant where it is treated by a granular activated carbon system and discharged to the K1 and K2 bog ditches via three vertical riser pipes (i.e., bubblers). The FS-1 ETD system has been optimized several times and is currently operating under pumping conditions specified by 2012 Scenario 01, which has a total flow rate of 425 gpm from two operating extraction wells (36EW0005 and 36EW0011).

## **FS-1 SPEIM ACTIVITIES**

The SPEIM program was developed to monitor plume changes and to ensure the effective operation of AFCEC groundwater remediation systems at the Massachusetts Military Reservation (MMR). These objectives are met through monitoring of selected media (i.e., groundwater, surface water) within and outside the plume boundaries, treatment plant monitoring, and groundwater flow and transport modeling. Activities completed for the FS-1 SPEIM program during 2012 include the following:

### **SPEIM Sampling Activities:**

- Triennial groundwater sampling (May 2012).
- Annual surface water sampling at the Quashnet River bog (August 2012).
- Semiannual extraction well sampling (May and December 2012).
- Monthly treatment system sampling (January 2012 through December 2012).
- Recording of daily average treatment system flow rates (January 2012 through December 2012).
- Influent sampling as part of an optimization flow test at 36EW0001 (January and April 2012).
- Supplemental sampling at monitoring wells (36MW0132A,B and 36MW1045A,B) located downgradient of 36EW0001 (July 2012 and October 2012).

The groundwater and surface water locations sampled for the FS-1 SPEIM program in 2012 are presented in [Figure 2](#). The well construction and surface water sample location information is included in [Table 1](#). The current approved FS-1 SPEIM network, including analytical scope and methods, is presented in the *Comprehensive Long Term Monitoring Plan*, which is available from AFCEC.

Groundwater and surface water analytical results are presented in [Table 2](#). A map showing the distribution of EDB detections in groundwater is included as [Figure 3](#). A comparison of compounds detected in groundwater and treatment plant samples to applicable standards is included in [Attachment A](#).

### **Data Summary Report:**

The data summary report for the analytical data reported in this SLR is included in [Attachment B](#).

### **Presentations:**

Presentations for the FS-1 plume are listed in [Table 3](#).

### **Project Note Submittals:**

The project notes related to activities conducted for the FS-1 plume under the SPEIM program in 2012 are included in [Attachment C](#).

### **Report Submittals:**

- *Fuel Spill-1 Groundwater Plume Conceptual Site Model* submitted in December 2012 (AFCEC 2012a).
- *Final 2011 MMR Vapor Intrusion Evaluation Technical Memorandum* submitted in August 2012 (AFCEE 2012a).
- *Fuel Spill-1 Groundwater Plume Conceptual Site Model* submitted in May 2012 (AFCEE 2012b).
- *Fuel Spill-1 2011 Summary Letter Report* submitted in March 2012 (AFCEE 2012c).

### **Major Events and Optimizations:**

Data collected under the SPEIM program indicated that, since system startup, the plume footprint and magnitude of EDB concentrations near 36EW0001 had decreased significantly (AFCEC 2012b). Therefore, in July 2011, the effective screen length of this extraction well was shortened to focus extraction stresses to the deeper portion of the aquifer. Influent sampling during flow testing of 36EW0001 was then conducted between July 2011 and April 2012 to identify an optimal flow rate for this extraction well. All of the flow rates tested resulted in non-detects for EDB or sustained influent concentrations that were less than the MMCL, indicating that the EDB remaining in the aquifer was very limited in extent and at low concentrations. On 08 May 2012, 36EW0001 shut down due to a failed variable frequency drive. Because groundwater monitoring and flow testing data indicated that only a very small area of low concentration EDB remains deep in the aquifer in the immediate vicinity of 36EW0001, AFCEC and regulatory agencies agreed that this extraction well would remain off-line on an interim basis while groundwater monitoring at and

downgradient of 36EW0001 was conducted. This monitoring effort consisted of groundwater sampling at four monitoring wells (36MW0132A,B and 36MW1045A,B) in July and October 2012. EDB was detected at only one monitoring well (36MW1045A; at the method detection limit of 0.005 µg/L) in July 2012, no EDB was detected in any other monitoring wells sampled in the July and October 2012 sampling events. Therefore, it was agreed that 36EW0001 would remain off-line, a new operating Scenario (2012 Scenario 01: 36EW0005 at 175 gpm and 36EW0011 at 250 gpm) would be implemented, and the SPEIM network for FS-1 would be optimized (AFCEC 2012b).

In December 2012, the FS-1 SPEIM network was optimized. The network optimization was completed because the footprint of the FS-1 plume had decreased significantly since the last network optimization (in 2006) and many of the monitoring wells included in the network were now located outside the plume footprint. In addition, newly installed monitoring wells (36MW1045A,B located near 36EW0001) were added to the monitoring network. The 2012 network optimization consisted of a spatial and temporal analysis for each monitoring well against the 2012 EDB plume boundary with the continued goal of collecting data to support plume and ETD system performance monitoring (AFCEC 2012b). The network optimization resulted in an approximate 38 percent decrease in the groundwater monitoring program at FS-1 (reduction from 48 to 30 groundwater samples collected on an annualized basis).

## **FS-1 REMEDIAL STATUS UPDATE**

Analytical results from the FS-1 treatment plant sampling are presented in [Table 4](#). Average weekly flow rates for the FS-1 extraction wells are presented in [Table 5](#). Treatment system operational downtimes or deviations (for events lasting two hours or longer) for 2012 are summarized in [Table 6](#). Mass removal calculations through December 2012 for the FS-1 treatment system are presented in [Table 7](#).

The most recent plume shell for the FS-1 plume included data collected through June 2006 (AFCEE 2007b). The 2006 FS-1 plume shell is estimated to contain approximately 459 million gallons of groundwater contaminated with EDB at concentrations above the MMCL; and approximately 1.15 pounds (lbs) of dissolved-phase EDB at concentrations above the MMCL.

The FS-1 ETD system removed approximately 0.064 lbs of EDB between January 2012 and December 2012. During this period, approximately 228 million gallons of groundwater were treated at the FS-1 treatment plant. Since system startup in April 1999, the system has removed approximately 17.93 lbs of EDB through the treatment of approximately 4 billion gallons of groundwater.

The operation of the FS-1 remedial system used approximately 270 megawatt hours of electricity during 2012. Power plant air emissions associated with this power generation for 2012 and since system startup in April 1999 are presented in [Table 8](#). Green energy purchases and power production from AFCEC's wind turbines are incorporated into these air emissions data.

The latest groundwater model transport simulations for the FS-1 plume were completed using the 2006 plume shell and flow rates specified in operating scenario 2007 Scenario 01 (36EW0001 at 90 gpm, 36EW0005 at 175 gpm, and 36EW0011 at 250 gpm). These transport simulations predict that the ETD system will continue to capture EDB until



approximately 2020. After that time a small area of low concentration EDB plume is predicted to remain in a basal silt at FS-1 through the last simulation time-step of 2031 (AFCEE 2007a). SPEIM data collected since the 2007 modeling simulations indicate that the FS-1 plume is remediating slightly faster than the timeframes presented in the 2007 simulations. Through the SPEIM program, the Conceptual Site Model is routinely updated and the remedial system operation is continuously evaluated and optimized to reduce cleanup times, therefore, the timeframes presented in this section will most likely be decreased in future scenarios.

### **FS-1 SPEIM ACTIVITIES PLANNED FOR 2013**

Activities currently planned for the FS-1 SPEIM program for 2013 include the following:

- Annual groundwater sampling (June 2013).
- Semiannual sampling of operating extraction wells (June 2013 and December 2013).
- Annual surface water sampling (August 2013).
- FS-1 SPEIM data presentations.
- Monthly treatment plant sampling (January 2013 through December 2013).
- Recording of daily average treatment system flow rates (January 2013 through December 2013).
- Synoptic water level measurements (as needed).
- Monitoring network and optimization evaluations (when appropriate).
- LUC Program private well verification surveys and sampling (as needed).

If you have any questions or comments, please contact Rose Forbes at (508) 968-4670, extension 5613.

Sincerely,

CH2M HILL



Nigel Tindall, P.G.  
Project Manager

Attachments:

<a href="#"><u>Figure 1</u></a>	FS-1 Groundwater Plume and Treatment System
<a href="#"><u>Figure 2</u></a>	FS-1 Groundwater and Surface Water Monitoring Locations
<a href="#"><u>Figure 3</u></a>	FS-1 2012 Ethylene Dibromide Detections in Groundwater
<a href="#"><u>Table 1</u></a>	FS-1 Well Construction and Surface Water Sampling Location Information
<a href="#"><u>Table 2</u></a>	FS-1 Groundwater and Surface Water Monitoring Results
<a href="#"><u>Table 3</u></a>	FS-1 Meeting Presentations
<a href="#"><u>Table 4</u></a>	FS-1 Treatment Plant Sampling Results
<a href="#"><u>Table 5</u></a>	FS-1 Treatment System Flow Rates
<a href="#"><u>Table 6</u></a>	FS-1 Treatment System Downtime Summary
<a href="#"><u>Table 7</u></a>	FS-1 Treatment System Mass Removal Summary
<a href="#"><u>Table 8</u></a>	FS-1 Remedial System Electrical Consumption and Associated Air Emissions

<a href="#"><u>Attachment A</u></a>	Comparison of Detected Concentrations in FS-1 Groundwater and Treatment Plant Samples to Applicable Groundwater Standards
<a href="#"><u>Attachment B</u></a>	FS-1 2012 SLR Data Summary Report
<a href="#"><u>Attachment C</u></a>	FS-1 Project Notes

\* c: Rose Forbes, AFCEC/MMR  
 Bob Lim, EPA  
 Leonard Pinaud, MassDEP  
 Denis LeBlanc, USGS  
 Glen Harrington, Mashpee BOH  
 Steve Hurley, MDFW

Martha Steele, MassDPH  
 Drew McManus, Mashpee Conserv.  
 Brad Chase, MA Div. of Marine Fisheries  
 Bill Fisher, Haley & Aldrich  
 CH2M HILL Doc. Control & Distribution

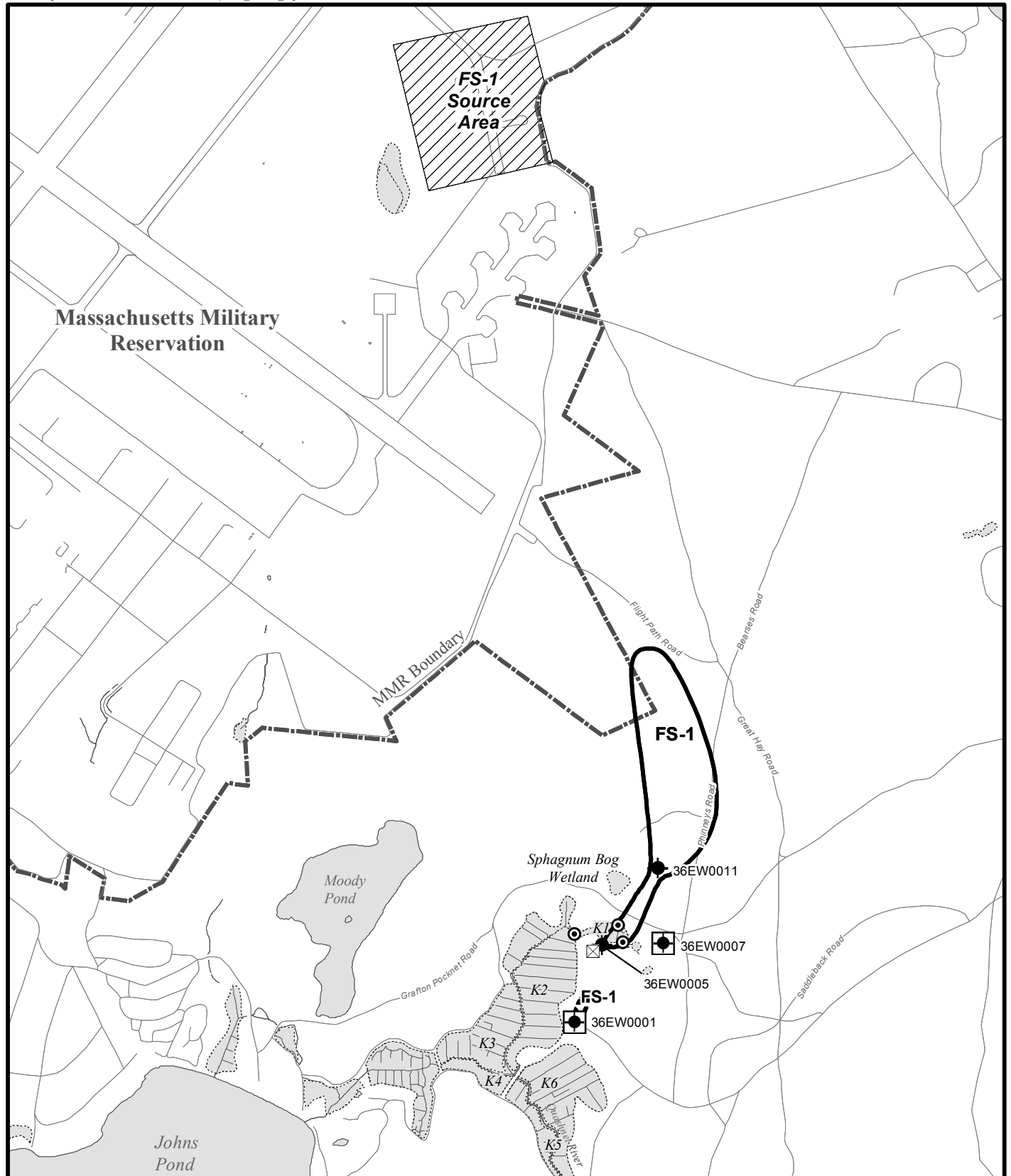
\* Delivery via email.

## REFERENCES

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- \_\_\_\_\_. 2012b (December). *FS-1 2012 Triennial SPEIM Data Presentation, Network Optimization, and Supplemental Monitoring Results Project Note*. 437075-SPEIM-FS1-PRJNOT-001. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.
- AFCEE (Air Force Center for Engineering and the Environment). 2012a (August). *Final 2011 MMR Vapor Intrusion Evaluation Technical Memorandum*. 420005-PROGRAM-MULTIPLE-TECHMEM-002. Prepared by CH2M HILL for AFCEE/MMR Installation Restoration Program, Otis Air National Guard Base, MA.
- \_\_\_\_\_. 2012b (May). *Fuel Spill-1 Groundwater Plume Conceptual Site Model*. 420005-SPEIM-FS1-CSM-0001. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.
- \_\_\_\_\_. 2012c (March). *Fuel Spill-1 2011 Summary Letter Report*. 420005-SPEIM-FS1-SLR-001. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.
- \_\_\_\_\_. 2011 (September). *Final Explanation of Significant Differences for the Installation Restoration Program Groundwater Plumes at the Massachusetts Military Reservation*. 404929-SPEIM-MULTIPLE-RPT-001. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.
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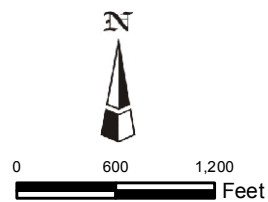
## FIGURES



### Legend

- |  |                       |  |   |
|--|-----------------------|--|---|
|  | Outflow Bubbler       |  | Massachusetts Military Reservation Boundary |
|  | Extraction Well (On)  |  | Plume Boundary (Dashed Where Inferred)      |
|  | Extraction Well (Off) |  | Bog/Wetland                                 |
|  | Treatment Plant       |  | Source Area                                 |

Data Source: AFCEC, January 2013, MMR-AFCEC Data Warehouse  
MMR Boundary from Massachusetts Air National Guard 2011

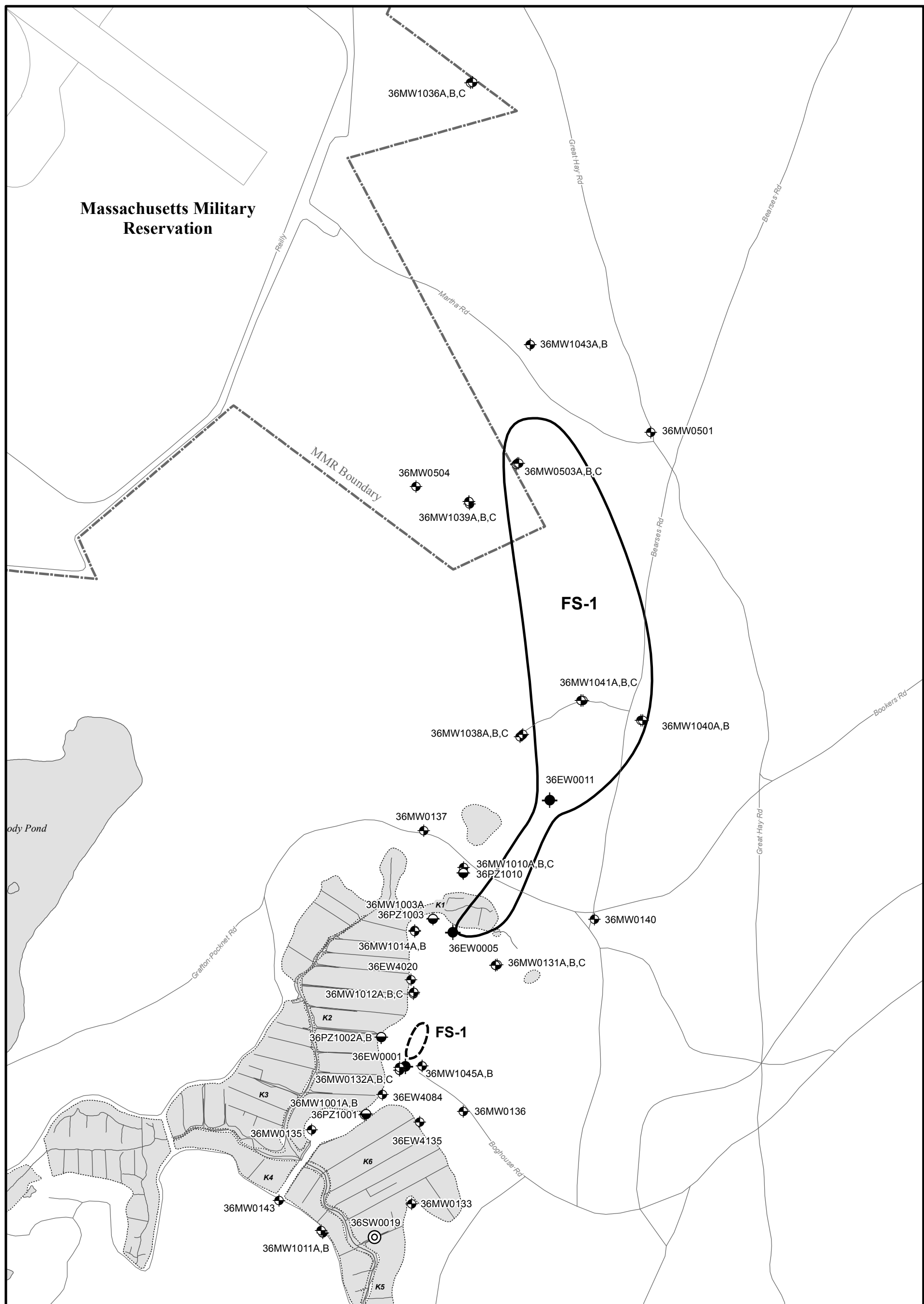


### FIGURE 1

### FS-1 GROUNDWATER PLUME AND TREATMENT SYSTEM

AFCEC - Massachusetts Military Reservation  
FS-1 2012 Summary Letter Report

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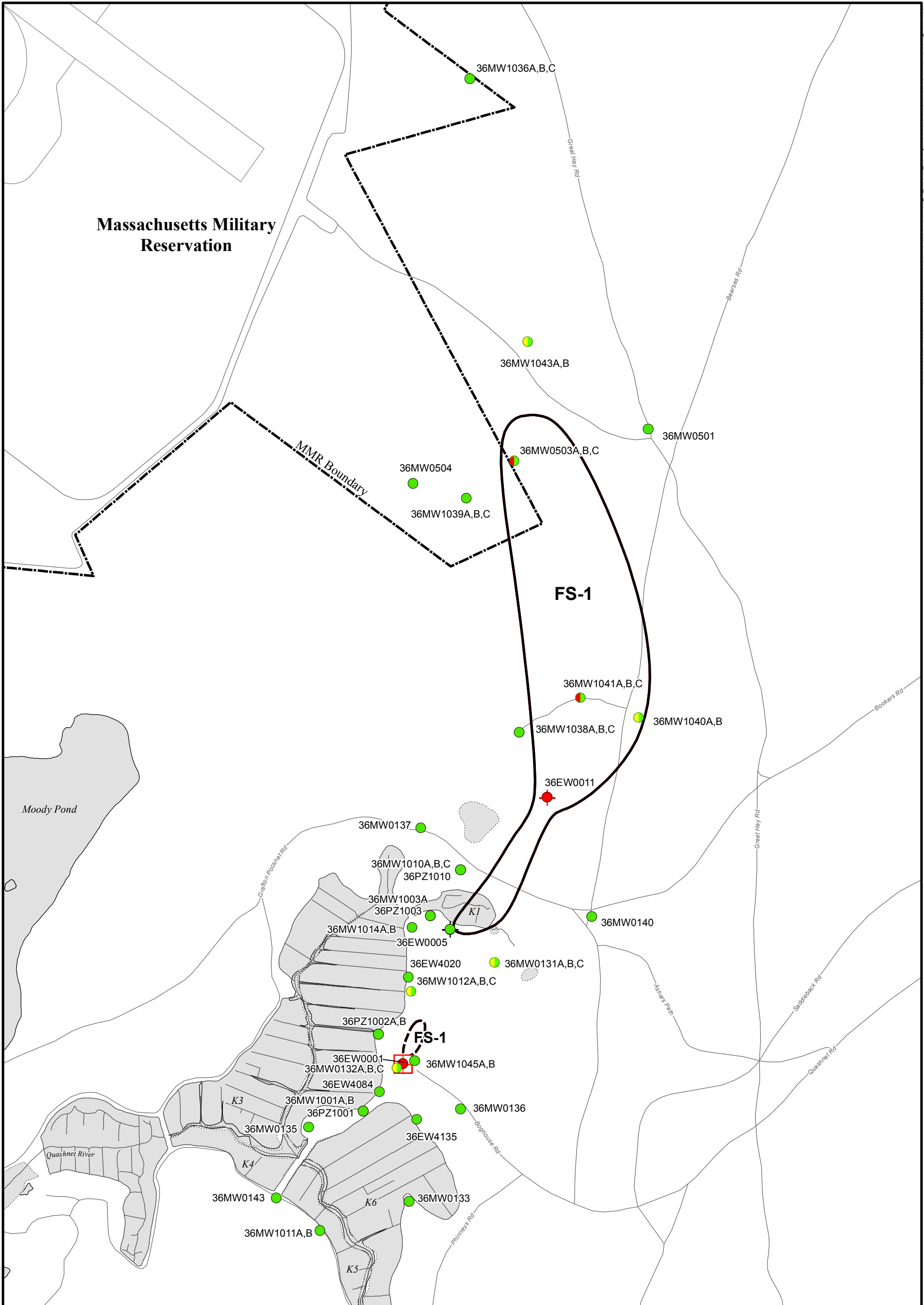
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**FIGURE 2**

**FS-1 GROUNDWATER AND  
SURFACE WATER MONITORING  
LOCATIONS**

AFCEC - Massachusetts Military Reservation  
*FS-1 2012 Summary Letter Report*

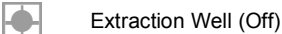




Data Source: AFCEC, January 2013, MMR-AFCEC Data Warehouse  
MMR Boundary from Massachusetts Air National Guard 2011

Legend

- Plume Boundary (Dashed Where Inferred)
- Massachusetts Military Reservation Boundary
- Bog/Wetland
- Extraction Well (On)



Extraction Well (Off)

Contaminant Detections:

- No Detection
- Detection Below or at MMCL
- Detection Above MMCL

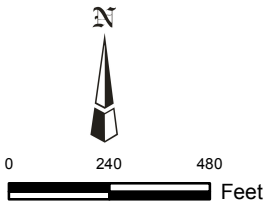


FIGURE 3

FS-1 2012 ETHYLENE DIBROMIDE  
DETECTIONS IN GROUNDWATER

AFCEC - Massachusetts Military Reservation  
FS-1 2012 Summary Letter Report

## **TABLES**

**Table 1**  
**FS-1 Well Construction and Surface Water Sampling Location Information**  
**FS-1 2012 Summary Letter Report**

Location	Northing (ft)	Easting (ft)	Surface Elevation (ft msl)	Measuring Point Elevation (ft msl)	Total Well Depth (ft bgs)	Top Screen Elevation (ft msl)	Bottom Screen Elevation (ft msl)	Screen Length (ft)
36EW0001 <sup>(1)</sup>	233941	871784	56.76	51.08	191	-103.05	-129.05	26
36EW0005 <sup>(2)</sup>	234603	872017	37.62	38.36	191	-138.38	-148.38	10
36EW0011 <sup>(3)</sup>	235254	872496	93.51	87.67	249	-88.66	-150.65	62
36EW4020 <sup>(4)</sup>	234368	871812	36.19	36.44	21	19.19	16.19	3
36EW4084 <sup>(4)</sup>	233801	871670	35.14	35.39	21	17.64	14.64	3
36EW4135 <sup>(4)</sup>	233665	871854	34.38	34.63	20	17.38	14.38	3
36MW0131A	234440	872236	52.15	54.39	186	-127.85	-132.85	5
36MW0131B	234440	872228	53.37	55.25	139	-80.63	-85.63	5
36MW0131C	234439	872228	53.37	55.3	90	-31.63	-36.63	5
36MW0132A	233922	871754	54.3	53.96	190	-130.7	-135.7	5
36MW0132B	233922	871754	54.3	53.96	140	-80.7	-85.7	5
36MW0132C	233936	871754	54.61	53.98	83	-23.39	-28.39	5
36MW0133	233262	871815	34.04	33.82	60	-20.96	-25.96	5
36MW0135	233628	871320	34.48	34.26	180	-140.52	-145.52	5
36MW0136	233717	872069	55.74	58.52	150	-89.74	-94.26	5
36MW0137	235103	871873	58.34	60.51	112	-47.66	-52.66	5
36MW0140	234665	872715	50.44	50.16	140	-84.56	-89.56	5
36MW0143	233279	871161	34.94	34.68	170	-130.06	-135.06	5
36MW0501	237066	872994	78.38	78.03	150	-66.62	-71.62	5
36MW0503A	236911	872331	103.21	102.97	195	-86.79	-91.79	5
36MW0503B	236913	872337	103.1	102.64	150	-41.9	-46.9	5
36MW0503C	236914	872343	102.87	102.64	120	-12.13	-17.13	5
36MW0504	236799	871836	78.85	78.46	182	-98.15	-103.15	5
36MW1001A	233707	871589	34.48	33.36	150	-110.52	-115.52	5
36MW1001B	233701	871582	34.63	34.13	100	-60.37	-65.37	5
36MW1003A	234670	871920	36.49	36.1	154	-112.61	-117.61	5
36MW1010A	234896	872068	49.37	51.62	231	-171.13	-181.13	10
36MW1010B	234922	872071	50.63	49.95	165	-109.37	-114.37	5
36MW1010C	234896	872068	49.37	51.64	86	-31.13	-36.13	5
36MW1011A	233120	871376	34.62	33.88	100	-60.38	-65.38	5
36MW1011B	233131	871368	34.84	34.45	25	14.84	9.84	5
36MW1012A	234298	871824	38.04	37.24	149	-106.06	-111.06	5
36MW1012B	234304	871825	38.1	37.64	78	-34.8	-39.8	5
36MW1012C	234304	871825	38.1	37.72	23	20.5	15.5	5
36MW1014A	234611	871830	36.37	36.17	99	-57.13	-62.13	5
36MW1014B	234607	871829	36.16	35.98	23	18.06	13.06	5
36MW1036A	238793	872114	107.97	107.37	263	-150.03	-154.98	5
36MW1036B	238790	872105	107.85	107.09	224	-111.05	-116.05	5
36MW1036C	238793	872115	107.97	107.37	176	-62.18	-67.13	5
36MW1038A	235573	872357	96.76	96.56	245	-142.94	-147.84	5
36MW1038B	235567	872350	96.95	96.18	204	-102.15	-106.95	5
36MW1038C	235578	872363	96.55	96.05	94	7.45	2.65	5
36MW1039A	236726	872097	101.43	100.97	254	-147.04	-151.99	5
36MW1039B	236715	872100	101.55	101.14	194	-87.45	-92.45	5
36MW1039C	236726	872097	101.43	100.96	144	-37.53	-42.48	5
36MW1040A	235648	872945	64.54	64.32	219	-149.18	-153.98	5
36MW1040B	235647	872953	64.49	64.19	134	-63.99	-68.82	5
36MW1041A	235745	872659	93.88	93.12	224	-125.22	-130.02	5
36MW1041B	235745	872650	93.95	93.52	155	-55.75	-60.65	5
36MW1041C	235745	872650	93.95	93.51	135	-35.85	-40.75	5
36MW1043A	237500	872399	104.58	104.23	255	-145.4	-150.19	5
36MW1043B	237499	872399	104.58	104.23	165	-55.26	-60.38	5
36MW1045A	233942	871866	58.4	58.02	185	-122	-126.57	5
36MW1045B	233942	871866	58.4	57.99	120	-56.98	-61.59	5
36PZ1001	233707	871589	33.9	33.36	7	31.9	26.9	5
36PZ1002A	234086	871664	33.74	33.46	130	-91.26	-96.26	5
36PZ1002B	234086	871664	33.74	33.62	7	31.74	26.74	5
36PZ1003	234670	871920	36.72	36.44	7	34.72	29.72	5
36PZ1010	234896	872069	49.37	51.64	30	24.37	19.37	5
36SW0019 <sup>(5)</sup>	233098	871632	29.48	N/A	N/A	N/A	N/A	N/A

Data Source: AFCEC, February 2013, MMR-AFCEC Data Warehouse

Notes:

1. The effective screen length at 36EW0001 was shortened to 26 feet in July 2011.
2. The effective screen length at 36EW0005 was shortened to 10 feet in October 2007 as part of the wellfield optimization.
3. The screen at 36EW0011 has a blank between -130.73 and -144.56 ft msl.
4. Extraction wells 36EW4020, 36EW4084, and 36EW4135 are decommissioned shallow wellpoints and are used for groundwater monitoring purposes only.
5. Locations have not been surveyed; location data is approximated.

Key:

bgs = below ground surface

ft = feet

msl = mean sea level

N/A = not applicable

**Table 2**  
**FS-1 Groundwater and Surface Water Monitoring Results**  
**FS-1 2012 Summary Letter Report**

Location	Date	EDB (µg/L) MMCL = 0.02 <sup>1</sup>	Water Quality Parameters					
			Temp (°C)	pH (std)	DO (mg/L)	SpC (µS/cm)	ORP (mV)	Turbidity (NTU)
Groundwater								
36EW0001	1/26/2012	0.011*	10.15	6.49	5.27	75	137.3	0
36EW0001	4/16/2012	0.031*	14.07	6.68	3.52	60	63.9	11.2
36EW0005	5/11/2012	0.01	11.73	6.23	6.7	72	90.8	1.6
36EW0005	12/18/2012	ND	11.11	6.86	11.56	75	114.3	0
36EW0011	5/11/2012	0.052	11.41	6.18	6.89	70	126	2
36EW0011	12/18/2012	0.028	11.02	6.76	9.86	72	129.9	0.4
36EW4020	5/21/2012	ND	--	--	--	--	--	--
36EW4084	5/21/2012	ND	--	--	--	--	--	--
36EW4135	5/21/2012	ND	--	--	--	--	--	--
36MW0131A	5/1/2012	BRL	--	--	--	--	--	--
36MW0131B	5/1/2012	ND	--	--	--	--	--	--
36MW0131C	5/1/2012	ND	--	--	--	--	--	--
36MW0132A	5/1/2012	ND	--	--	--	--	--	--
36MW0132A	6/29/2012	ND	--	--	--	--	--	--
36MW0132A	10/3/2012	ND	--	--	--	--	--	--
36MW0132B	5/1/2012	ND	--	--	--	--	--	--
36MW0132B	6/29/2012	ND	--	--	--	--	--	--
36MW0132B	10/3/2012	ND	--	--	--	--	--	--
36MW0132C	5/1/2012	BRL	--	--	--	--	--	--
36MW0133	5/4/2012	ND	--	--	--	--	--	--
36MW0135	5/4/2012	ND	--	--	--	--	--	--
36MW0136	5/1/2012	ND	--	--	--	--	--	--
36MW0137	5/4/2012	ND	--	--	--	--	--	--
36MW0140	5/4/2012	ND	--	--	--	--	--	--
36MW0143	5/4/2012	ND	--	--	--	--	--	--
36MW0501	5/7/2012	ND	--	--	--	--	--	--
36MW0503A	5/7/2012	0.029	--	--	--	--	--	--
36MW0503B	5/7/2012	ND	--	--	--	--	--	--
36MW0503C	5/7/2012	ND	--	--	--	--	--	--
36MW0504	5/7/2012	ND	--	--	--	--	--	--
36MW1001A	5/21/2012	ND	--	--	--	--	--	--
36MW1001B	5/21/2012	ND	--	--	--	--	--	--
36MW1003A	5/21/2012	ND	--	--	--	--	--	--
36MW1010A	5/7/2012	ND	--	--	--	--	--	--
36MW1010B	5/7/2012	ND	--	--	--	--	--	--
36MW1010C	5/7/2012	ND	--	--	--	--	--	--
36MW1011A	5/4/2012	ND	--	--	--	--	--	--
36MW1011B	5/4/2012	ND	--	--	--	--	--	--
36MW1012A	5/21/2012	ND	--	--	--	--	--	--
36MW1012B	5/21/2012	0.01	--	--	--	--	--	--
36MW1012C	5/21/2012	ND	--	--	--	--	--	--
36MW1014A	5/21/2012	ND	--	--	--	--	--	--
36MW1014B	5/21/2012	ND	--	--	--	--	--	--
36MW1036A	5/21/2012	ND	--	--	--	--	--	--
36MW1036B	5/21/2012	ND	--	--	--	--	--	--
36MW1036C	5/21/2012	ND	--	--	--	--	--	--
36MW1038A	5/3/2012	ND	--	--	--	--	--	--
36MW1038B	5/3/2012	ND	--	--	--	--	--	--
36MW1038C	5/3/2012	ND	--	--	--	--	--	--
36MW1039A	5/7/2012	ND	--	--	--	--	--	--
36MW1039B	5/7/2012	ND	--	--	--	--	--	--
36MW1039C	5/7/2012	ND	--	--	--	--	--	--
36MW1040A	5/3/2012	0.013	--	--	--	--	--	--
36MW1040B	5/3/2012	ND	--	--	--	--	--	--
36MW1041A	5/3/2012	0.102	--	--	--	--	--	--
36MW1041B	5/3/2012	ND	--	--	--	--	--	--
36MW1041C	5/3/2012	ND	--	--	--	--	--	--
36MW1043A	5/7/2012	ND	--	--	--	--	--	--
36MW1043B	5/7/2012	BRL	--	--	--	--	--	--
36MW1045A	5/14/2012	ND	13.15	6.69	0.36	89	-58.4	7
36MW1045A	7/2/2012	BRL	15.03	6.57	0.39	111	-123.2	10.5
36MW1045A	10/3/2012	ND	--	--	--	--	--	--
36MW1045B	5/14/2012	ND	12.47	6.42	5.56	76	96.8	6.8
36MW1045B	7/2/2012	ND	15.48	6.29	5.07	91	-111.5	6.5
36MW1045B	10/3/2012	ND	--	--	--	--	--	--
36PZ1001	5/22/2012	ND	--	--	--	--	--	--

**Table 2**  
**FS-1 Groundwater and Surface Water Monitoring Results**  
**FS-1 2012 Summary Letter Report**

Location	Date	EDB (µg/L) MMCL = 0.02 <sup>1</sup>	Water Quality Parameters					
			Temp (°C)	pH (std)	DO (mg/L)	SpC (µS/cm)	ORP (mV)	Turbidity (NTU)
36PZ1002A	5/22/2012	ND	10.98	6.32	8.29	65	199.3	33.9
36PZ1002B	5/22/2012	ND	12.83	5.73	4.8	55	204.1	6
36PZ1003	5/22/2012	ND	13.25	6.21	11.52	59	195	103
36PZ1010	5/7/2012	ND	10.4	5.79	4.72	87	-47.1	1
<b>Surface Water</b>								
36SW0019	8/15/2012	ND <sup>2,3</sup>	--	--	--	--	--	--

Data Source: AFCEC, February 2013, MMR-AFCEC Data Warehouse

Notes :

1. MMCL from Massachusetts Department of Environmental Protection (MassDEP) web page, <http://www.mass.gov/dep/water/dwstand.pdf>.
2. EDB screening-level risk based concentration for imminent human health risk ( $10^{-3}$  risk) = 6.5 µg/L: *Preliminary Screening-Level Human Health Risk Evaluation for Fuel Spill-1 Surface Water and Treatment System Data* ; Appendix D of *Final Fuel Spill-1 2002 Annual System Performance and Ecological Impact Monitoring Report* , dated May 2003.
3. EDB screening-level ecological benchmark for surface water = 31 µg/L: *Final Ethylene Dibromide Derivation of Aquatic Screening Benchmarks*, dated November 1998.

\* Sample was collected immediately upon startup of extraction well (i.e. one well volume purge) after a rest period.

**Bold** values represent EDB concentrations above the MMCL .

--: Sample collected through use of passive diffusion bag sampler; water quality parameter collection not performed.

Key:

BRL = below reporting limit

°C = degrees Celsius

DO = dissolved oxygen

EDB = ethylene dibromide

mg/L = milligrams per liter

MMCL = Massachusetts Maximum Contaminant Level

mV = millivolts

ND = not detected

NTU = nephelometric turbidity units

ORP = oxidation-reduction potential

SpC = specific conductance

std = standard units

Temp = temperature

µg/L = micrograms per liter

µS/cm = microsiemens per centimeter

**Table 3**  
**FS-1 Meeting Presentations**  
**FS-1 2012 Summary Letter Report**

**Technical Update Meetings**

26 January 2012	FS-1 ETD Optimization Update
26 January 2012	FS-1 2011 Annual SPEIM Data Presentation Follow Up
26 January 2012	FS-1 Source Area Groundwater Monitoring Update
26 April 2012	FS-1 ETD System Optimization
27 September 2012	FS-1 2012 Triennial SPEIM Data Presentation and SPEIM Monitoring Network Optimization
28 November 2012	FS-1 2012 Triennial SPEIM Data Presentation and SPEIM Monitoring Network Optimization Follow Up
28 November 2012	FS-1 Monitoring Downgradient of 36EW0001

**MMR Cleanup Team (MMRCT)**

No presentations

**SMB Meetings**

No presentations

**Conferences**

No presentations



**Table 4**  
**FS-1 Treatment Plant Sampling Results**  
**FS-1 2012 Summary Letter Report**

Month of Event	Sample Date	Location Identification	Sample Location	Laboratory Analyses	Water Quality Parameters					
				EDB (µg/L) MMCL = 0.02	Temp (°C)	SpC (µS/cm)	DO (mg/L)	pH (std)	ORP (mV)	Turbidity (NTU)
February	30-Jan-12	36PLT02001	Combined Influent	0.040	--	--	--	--	--	--
		36PLT02002	Post GAC 101 Lag	0.011	--	--	--	--	--	--
		36PLT02005	Plant Effluent	ND	--	--	--	--	--	--
Carbon was exchanged in CF103 on 10 February 2012. Following the exchange, CF101 became the lead GAC vessel, CF102 became the lag vessel and CF103 became the polishing vessel.										
March	27-Feb-12	36PLT02001	Combined Influent	0.036	--	--	--	--	--	--
		36PLT02003	Post GAC 102Lag	ND	--	--	--	--	--	--
		36PLT02005	Plant Effluent	ND	--	--	--	--	--	--
April	27-Mar-12	36PLT02001	Combined Influent	0.041	--	--	--	--	--	--
		36PLT02003	Post GAC 102Lag	BRL	--	--	--	--	--	--
		36PLT02005	Plant Effluent	ND	--	--	--	--	--	--
May	26-Apr-12	36PLT02001	Combined Influent	0.033	--	--	--	--	--	--
		36PLT02003	Post GAC 102Lag	ND	--	--	--	--	--	--
		36PLT02005	Plant Effluent	ND	--	--	--	--	--	--
June	29-May-12	36PLT02001	Combined Influent	0.037 J	10.21	75	6.65	6.58	208.2	0.3
		36PLT02003	Post GAC 102Lag	BRL	10.25	75	5.72	6.45	218.7	0.0
		36PLT02005	Plant Effluent	ND	10.27	74	5.91	6.04	243.5	0.0
July	26-Jun-12	36PLT02001	Combined Influent	0.039	--	--	--	--	--	--
		36PLT02003	Post GAC 102Lag	0.013	--	--	--	--	--	--
		36PLT02005	Plant Effluent	ND	--	--	--	--	--	--
Carbon was exchanged in CF101 on 25 July 2012. Following the exchange, CF102 became the lead GAC vessel, CF103 became the lag vessel and CF101 became the polishing vessel.										
August	18-Jul-12	36PLT02001	Combined Influent	NS	--	--	--	--	--	--
		36PLT02004	Post GAC 103 Lag	NS	--	--	--	--	--	--
		36PLT02005	Plant Effluent	NS	--	--	--	--	--	--

**Table 4**  
**FS-1 Treatment Plant Sampling Results**  
**FS-1 2012 Summary Letter Report**

Month of Event	Sample Date	Location Identification	Sample Location	Laboratory Analyses	Water Quality Parameters					
				EDB (µg/L) MMCL = 0.02	Temp (°C)	SpC (µS/cm)	DO (mg/L)	pH (std)	ORP (mV)	Turbidity (NTU)
September	28-Aug-12	36PLT02001	Combined Influent	<b>0.035</b>	--	--	--	--	--	--
		36PLT02004	Post GAC 103 Lag	ND	--	--	--	--	--	--
		36PLT02005	Plant Effluent	ND	--	--	--	--	--	--
October	27-Sep-12	36PLT02001	Combined Influent	<b>0.031</b>	--	--	--	--	--	--
		36PLT02004	Post GAC 103 Lag	ND	--	--	--	--	--	--
		36PLT02005	Plant Effluent	ND	--	--	--	--	--	--
November	25-Oct-12	36PLT02001	Combined Influent	<b>0.026</b>	--	--	--	--	--	--
		36PLT02004	Post GAC 103 Lag	ND	--	--	--	--	--	--
		36PLT02005	Plant Effluent	ND	--	--	--	--	--	--
December	28-Nov-12	36PLT02001	Combined Influent	<b>0.026</b>	10.04	66	7.34	6.27	197.8	0.0
		36PLT02004	Post GAC 103 Lag	BRL	10.04	66	6.42	6.26	203.5	0.0
		36PLT02005	Plant Effluent	ND	10.05	65	6.29	6.29	204.5	0.0
January	26-Dec-12	36PLT02001	Combined Influent	<b>0.022</b>	--	--	--	--	--	--
		36PLT02004	Post GAC 103 Lag	ND	--	--	--	--	--	--
		36PLT02005	Plant Effluent	ND	--	--	--	--	--	--

Data Source: AFCEC, February 2013, MMR-AFCEC Data Warehouse

Notes:

**Bold** values represent EDB concentration above MMCL.

Water quality parameters (pH, temperature, dissolved oxygen, conductivity, turbidity and oxidation/reduction potential) are measured semiannually at influent, post-GAC at each active GAC vessel, and plant effluent sampling locations. The measurements are taken using a flow-thru cell and the Yellow Springs Instrument (YSI).

--: Water quality parameters were not collected.

Key:

BRL = below reporting limit

°C = degrees Celsius

DO = dissolved oxygen

EDB = ethylene dibromide

GAC = granular activated carbon

J = estimated value

mg/L = milligrams per liter

MMCL = Massachusetts Maximum Contaminant Level

mV = millivolts

ND = not detected

NTU = nephelometric turbidity units

NS = samples not collected due to carbon changeout

ORP = oxidation-reduction potential

SpC = specific conductance

Temp = temperature

µg/L = micrograms per liter

µS/cm = microseimens per centimeter

**Table 5**  
**FS-1 Treatment System Flow Rates**  
**FS-1 2012 Summary Letter Report**

Week Ending	36EW0001 Flow Rate (gpm)	36EW0005 Flow Rate (gpm)	36EW0011 Flow Rate (gpm)	Treatment Plant Total Flow (gpm)
<b>2007 Scenario 01</b>				
7-Jan-12	45	175	250	470
14-Jan-12	45	175	250	470
21-Jan-12	45	175	250	470
28-Jan-12	45	175	250	470
4-Feb-12	45	175	250	470
11-Feb-12	45	175	249	469
18-Feb-12	45	175	250	470
25-Feb-12	43	169	242	454
3-Mar-12	45	175	250	470
10-Mar-12	45	175	248	468
17-Mar-12	45	175	246	466
24-Mar-12	45	175	245	465
31-Mar-12	45	175	243	463
7-Apr-12	45	175	242	462
14-Apr-12	16	175	246	437
21-Apr-12	36	175	250	461
28-Apr-12	45	175	250	470
5-May-12	44	173	247	464
<b>Average Flow Rate (gpm)</b>	<b>43</b>	<b>175</b>	<b>248</b>	<b>465</b>
<b>Optimized Design Flow Rate (gpm) (2007 Scenario 01)</b>	<b>90</b>	<b>175</b>	<b>250</b>	<b>515</b>
<b>Percent of Optimized Design Rate</b>	<b>48*</b>	<b>100</b>	<b>99</b>	<b>90</b>
<b>2012 Scenario 01</b>				
12-May-12	13	168	239	420
19-May-12	N/A	175	250	425
26-May-12	N/A	170	239	409
2-Jun-12	N/A	165	235	400
9-Jun-12	N/A	175	250	425
16-Jun-12	N/A	175	250	425
23-Jun-12	N/A	175	250	425
30-Jun-12	N/A	175	250	425
7-Jul-12	N/A	175	250	425
14-Jul-12	N/A	157	226	384
21-Jul-12	N/A	175	250	425
28-Jul-12	N/A	167	239	406
4-Aug-12	N/A	175	250	425
11-Aug-12	N/A	175	250	425
18-Aug-12	N/A	175	250	425
25-Aug-12	N/A	175	250	425
1-Sep-12	N/A	175	250	425
8-Sep-12	N/A	175	250	425
15-Sep-12	N/A	175	250	425
22-Sep-12	N/A	175	250	425
29-Sep-12	N/A	175	250	425
6-Oct-12	N/A	175	234	409

**Table 5**  
**FS-1 Treatment System Flow Rates**  
**FS-1 2012 Summary Letter Report**

<b>Week Ending</b>	<b>36EW0001 Flow Rate (gpm)</b>	<b>36EW0005 Flow Rate (gpm)</b>	<b>36EW0011 Flow Rate (gpm)</b>	<b>Treatment Plant Total Flow (gpm)</b>
13-Oct-12	N/A	175	250	425
20-Oct-12	N/A	175	250	425
27-Oct-12	N/A	175	250	425
3-Nov-12	N/A	150	211	361
10-Nov-12	N/A	175	247	422
17-Nov-12	N/A	175	248	423
24-Nov-12	N/A	175	246	421
1-Dec-12	N/A	174	245	419
8-Dec-12	N/A	174	245	419
15-Dec-12	N/A	175	250	425
22-Dec-12	N/A	175	250	425
29-Dec-12	N/A	175	250	425
<b>Average Flow Rate (gpm)</b>	<b>N/A</b>	<b>173</b>	<b>246</b>	<b>419</b>
<b>Optimized Design Flow Rate (gpm) (2012 Scenario 01)</b>	<b>N/A</b>	<b>175</b>	<b>250</b>	<b>425</b>
<b>Percent of Optimized Design Rate</b>	<b>N/A</b>	<b>99</b>	<b>98</b>	<b>99</b>

Data Source: AFCEC, February 2013, MMR-AFCEC Data Warehouse.

Notes:

Flow rates presented are weekly averages.

Any downtimes due to routine and non-routine operations and maintenance activities were included in the average flow rates.

\* 36EW0001 operated at lower flow rates as part of a flow test optimization evaluation.

Key:

gpm = gallons per minute

N/A = not applicable. 36EW0001 taken offline on 08 May 2012.

**Table 6**  
**FS-1 Treatment System Downtime Summary**  
**FS-1 2012 Summary Letter Report**

Date	Hours Off-Line	Reason
2/22/2012	4.58	Plant tripped off due to a power failure.
4/9/2012	165.55	36EW0001 for optimization sampling.
5/1/2012	14.33	Power outage.
5/22/2012	4.82	Plant tripped off due to a power failure.
5/23/2012	2.10	Plant tripped off due to a power failure.
5/31/2012	10.02	Plant tripped off due to a power failure.
5/31/2012	6.16	System tripped power failure.
7/12/2012	15.72	Energy curtailment.
7/24/2012	4.25	Plant tripped off due to vault flooded 36EW0001 (heavy rains).
7/24/2012	12.17	Plant tripped due to a power failure.
9/30/2012	10.68	Plant tripped off due to a power failure.
10/29/2012	21.42	Intentionally shut plant down due to hurricane/possible energy curtailment.
11/1/2012	6.72	System tripped 36EW0011 power.
12/29/2012	30.85	Plant tripped off due to a power failure. Restart 36EW0005.
12/29/2012	36.48	36EW0011 off due to VFD fault; vault flooded/sump 36EW0011 and restart.

Key:

VFD = variable frequency drive

**Table 7**  
**FS-1 Treatment System Mass Removal Summary**  
**FS-1 2012 Summary Letter Report**

Date	36EW0001 <sup>(1)</sup>		36EW0005		36EW0007 <sup>(2)</sup>		36EW0011		Total EDB Removed (Extraction Well Sampling)		Total EDB Removed (Plant Influent Sampling)	
	Incremental Mass Removed (lbs)	Cumulative Mass Removed (lbs)	Incremental Mass Removed (lbs)	Cumulative Mass Removed (lbs)	Incremental Mass Removed (lbs)	Cumulative Mass Removed (lbs)	Incremental Mass Removed (lbs)	Cumulative Mass Removed (lbs)	Incremental Mass Removed (lbs)	Cumulative Mass Removed (lbs)	Incremental Mass Removed (lbs)	Cumulative Mass Removed (lbs)
Jan-12	0.000	0.807	0.001	1.424	NA	1.095	0.004	3.911	0.005	7.237	0.007	7.563
Feb-12	0.000	0.807	0.001	1.425	NA	1.095	0.004	3.915	0.005	7.242	0.006	7.569
Mar-12	0.000	0.807	0.001	1.425	NA	1.095	0.004	3.919	0.005	7.246	0.007	7.576
Apr-12	0.000	0.807	0.001	1.426	NA	1.095	0.004	3.924	0.005	7.252	0.005	7.582
May-12	NA	0.807	0.001	1.427	NA	1.095	0.004	3.928	0.005	7.257	0.006	7.587
Jun-12	NA	0.807	0.001	1.427	NA	1.095	0.004	3.932	0.005	7.261	0.006	7.593
Jul-12	NA	0.807	0.001	1.428	NA	1.095	0.004	3.937	0.005	7.267	0.005	7.599
Aug-12	NA	0.807	0.001	1.429	NA	1.095	0.004	3.941	0.005	7.272	0.006	7.605
Sep-12	NA	0.807	0.001	1.43	NA	1.095	0.004	3.945	0.005	7.277	0.005	7.61
Oct-12	NA	0.807	0.001	1.43	NA	1.095	0.004	3.95	0.005	7.282	0.004	7.614
Nov-12	NA	0.807	0.001	1.431	NA	1.095	0.004	3.954	0.005	7.287	0.004	7.618
Dec-12	NA	0.807	0.001	1.432	NA	1.095	0.004	3.958	0.005	7.292	0.003	7.621
<b>EDB Removed (lbs) by Final ETD System (January 2012 - December 2012)</b>						<b>0.064</b>						
<b>EDB Removed (lbs) by Final ETD System since startup (September 2003 - December 2012) <sup>3</sup></b>						<b>7.62</b>						
<b>EDB Removed (lbs) by Interim ETD System (April 1999 - October 2002) <sup>4</sup></b>						<b>10.31</b>						
<b>Total EDB Mass Removed (lbs) between April 1999 and December 2012</b>						<b>17.93</b>						

Data Source: AFCEC, February 2013, MMR-AFCEC Data Warehouse

Notes:

1. 36EW0001 turned off 08 May 2012.
2. 36EW0007 turned off 01 October 2007 as part of the ETD system optimization.
3. Final ETD system began operation on 30 September 2003.
4. Interim ETD system operated between April 1999 and October 2002.

Key:

ETD = extraction, treatment, and discharge

EDB = ethylene dibromide

lbs = pounds

NA = not applicable, extraction well no longer operating.



**Table 8**  
**FS-1 Remedial System Electrical Consumption and Associated Air Emissions**  
**FS-1 2012 Summary Letter Report**

Volume of Groundwater Treated (million gallons)		1/1/2012 to 12/31/2012	System Startup (4/1999) to 12/31/2012 <sup>4</sup>
		228	4,053
Groundwater COC Mass Removal (pounds)		0.064	17.93
Electrical Usage (MWh)		270	4,791
Estimated Air Emissions <sup>1</sup> (based on electrical usage)	CO <sub>2</sub> (tons)	177	3,173
	NO <sub>x</sub> (lbs)	381	6,727
	PM-10 (lbs)	22	379
	SO <sub>2</sub> (lbs)	1,015	17,502
	VOCs (lbs)	13	238
Estimated Reduction in Air Emissions due to Green Power Purchases <sup>2</sup>	CO <sub>2</sub> (tons)	54	456
	NO <sub>x</sub> (lbs)	116	866
	PM-10 (lbs)	7	43
	SO <sub>2</sub> (lbs)	308	1,817
	VOCs (lbs)	4	33
Estimated Reduction in Air Emissions due to MMR Wind Turbine Operation <sup>3</sup>	CO <sub>2</sub> (tons)	182	294
	NO <sub>x</sub> (lbs)	392	632
	PM-10 (lbs)	22.4	36.2
	SO <sub>2</sub> (lbs)	1,046	1685
	VOCs (lbs)	13.7	22.1
Estimated Total Air Emissions with consideration of Green Power Purchases and MMR Wind Turbine Operation	CO <sub>2</sub> (tons)	0	2,483
	NO <sub>x</sub> (lbs)	0	5,355
	PM-10 (lbs)	0	308
	SO <sub>2</sub> (lbs)	0	14,339
	VOCs (lbs)	0	187

**Notes:**

1) The estimated air emissions presented in this table are based on the assumption that until 4/30/2009, the power used to operate the MMR remedial systems was provided by the Mirant Canal Station power plant in Sandwich, MA. This power plant primarily produced electricity generated by the combustion of fuel oil and has been off-line since 5/1/2009. Starting on 5/1/2009, air emissions are based on electricity generated by the average mix of power sources in Massachusetts. Air emissions were calculated using MMR utility data from AFCEC's Metrix 4 Utility Accounting Software

(<http://www.abraxasenergy.com/metrix4.php>) and emission factors obtained from the following websites:

<http://www.csqnetwork.com/elecpowerpolcalc.html>

<http://www.metrixcentral.com/EmissionsCalculator/Emissions%20Factors%202004.pdf>

2) Emissions offset by purchases of electricity from renewable sources beginning 7/1/2008 and ending on 8/1/2012.

3) Emissions offset by operation of AFCEC-owned wind turbines beginning on 12/2/2009 (Wind I) and 11/8/2011 (Wind II).

4) System was not operational between October 2002 and September 2003, system was down due to a fire that consumed the original plant.

**Key:**

COC = contaminant of concern

CO<sub>2</sub> = carbon dioxide

FS-1 = Fuel Spill-1

lbs = pounds

MMR = Massachusetts Military Reservation

MWh = megawatt hours

NO<sub>x</sub> = nitrogen oxides

PM-10 = particulate matter with a diameter of 10 micrometers or less

SO<sub>2</sub> = sulfur dioxide

VOCs = volatile organic compounds

**ATTACHMENT A**  
**Comparison of Detected Concentrations in FS-1 Groundwater  
and Treatment Plant Samples to Applicable Groundwater  
Standards**

**Attachment A**  
**Comparison of Detected Concentrations in FS-1 Groundwater and Treatment Plant Samples to Applicable Groundwater Standards**  
**FS-1 2012 Summary Letter Report**

Location	Date	Sample Elevation (ft msl)	Matrix	Test	Analyte	Result	DL	RL	Standard	Type <sup>1</sup>	Standard Exceeded?
						All Units = µg/L					
36EW0001	1/26/2012	-66.98	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.011	0.005	0.01	0.02	MMCL	No
36EW0001	4/16/2012	-66.98	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.031	0.005	0.01	0.02	MMCL	Yes
36EW0005	5/11/2012	-143.38	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.01	0.005	0.01	0.02	MMCL	No
36EW0011	5/11/2012	-119.66	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.052	0.005	0.01	0.02	MMCL	Yes
36EW0011	12/18/2012	-119.66	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.028	0.005	0.01	0.02	MMCL	Yes
36MW0131A	5/1/2012	-130.35	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	BRL	0.005	0.01	0.02	MMCL	No
36MW0132C	5/1/2012	-25.89	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	BRL	0.005	0.01	0.02	MMCL	No
36MW0503A	5/7/2012	-89.29	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.029	0.005	0.01	0.02	MMCL	Yes
36MW1012B	5/21/2012	-37.30	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.01	0.005	0.01	0.02	MMCL	No
36MW1040A	5/3/2012	-151.58	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.013	0.005	0.01	0.02	MMCL	No
36MW1041A	5/3/2012	-127.62	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.102	0.005	0.01	0.02	MMCL	Yes
36MW1043B	5/7/2012	-57.82	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	BRL	0.005	0.01	0.02	MMCL	No
36MW1045A	7/2/2012	-124.29	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	BRL	0.005	0.01	0.02	MMCL	No
36PLT02001 (INF)	1/30/2012	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.04	0.005	0.01	0.02	MMCL	Yes
36PLT02001 (INF)	2/27/2012	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.036	0.005	0.01	0.02	MMCL	Yes
36PLT02001 (INF)	3/27/2012	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.041	0.005	0.01	0.02	MMCL	Yes
36PLT02001 (INF)	4/26/2012	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.033	0.005	0.01	0.02	MMCL	Yes
36PLT02001 (INF)	5/29/2012	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.037J	0.005	0.01	0.02	MMCL	Yes
36PLT02001 (INF)	6/26/2012	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.039	0.005	0.01	0.02	MMCL	Yes
36PLT02001 (INF)	8/28/2012	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.035	0.005	0.01	0.02	MMCL	Yes
36PLT02001 (INF)	9/27/2012	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.031	0.005	0.01	0.02	MMCL	Yes
36PLT02001 (INF)	10/25/2012	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.026	0.005	0.01	0.02	MMCL	Yes
36PLT02001 (INF)	11/28/2012	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.026	0.005	0.01	0.02	MMCL	Yes
36PLT02001 (INF)	12/26/2012	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.022	0.005	0.01	0.02	MMCL	Yes
36PLT02002 (MID)	1/30/2012	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.011	0.005	0.01	0.02	MMCL	No
36PLT02003 (MID)	3/27/2012	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	BRL	0.005	0.01	0.02	MMCL	No
36PLT02003 (MID)	5/29/2012	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	BRL	0.005	0.01	0.02	MMCL	No
36PLT02003 (MID)	6/26/2012	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.013	0.005	0.01	0.02	MMCL	No
36PLT02004 (MID)	11/28/2012	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	BRL	0.005	0.01	0.02	MMCL	No

Data Source: AFCEC, February 2013, MMR-AFCEC Data Warehouse

Note:

1. MMCL from Massachusetts Department of Environmental Protection (MassDEP) web page, <http://www.mass.gov/dep/water/dwstand.pdf>.

Key:

BRL = below reporting limit

DL = detection limit

EDB = ethylene dibromide

ft msl = feet mean sea level

INF = treatment plant influent

J = estimated value

MID = treatment plant midpoint sample

MMCL = Massachusetts Maximum Contaminant Level

N/A = information not applicable

RL = reporting limit

WG = groundwater sample

WW = plant water sample

µg/L = micrograms per liter

**ATTACHMENT B**  
**FS-1 2012 SLR**  
**Data Summary Report**

**Attachment B**  
**Data Summary Report**  
**Fuel Spill-1 2012 Summary Letter Report**

## **INTRODUCTION**

The objective of this data summary report (DSR) is to assess the data quality of analytical results for samples collected for the Fuel Spill-1 System Performance and Ecological Impact Monitoring (SPEIM) Program at the Massachusetts Military Reservation (MMR) as presented in the *Fuel Spill-1 2012 Summary Letter Report*. This report is intended as a general data quality assessment designed to summarize data issues.

## **ANALYTICAL DATA**

This DSR covers 70 groundwater samples with one field duplicate sample, one surface water sample, and 33 wastewater samples. Field duplicates are not required for treatment facility plant samples. These samples were reported under 26 sample delivery groups. Samples were collected between 26 January 2012 and 26 December 2012. The analyses were performed by Analytics Environmental Laboratory LLC (ANAP) in Portsmouth, New Hampshire. Samples were collected and shipped by overnight carrier to ANAP for analysis. Samples were analyzed for the analytes/methods provided in Table B-1.

**Table B-1**  
**Analytical Parameter**

<b>Parameter</b>	<b>Method</b>	<b>Laboratory</b>
Ethylene Dibromide (EDB)	E504.1	ANAP

E = Environmental Protection Agency (EPA) Method

The data were assessed using the MMR SPEIM Quality Assurance Project Plan (QAPP)<sup>1</sup>. The assessment included a review of the following:

- Chain-of-Custody documentation

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<sup>1</sup>AFCEE. 2012 (July). *AFCEE MMR SPEIM/LTM/O&M Program Quality Assurance Project Plan*. 420005-Program-Multiple-QAPP-001. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

- Holding time compliance
- Required quality control (QC) samples at the specified frequencies
- Method blanks
- Laboratory control spiking samples
- Surrogate spike recoveries
- Initial and continuing calibration information and other method-specific criteria as defined by the SPEIM QAPP

Field samples were reviewed to ascertain field compliance and data quality issues. This included a review of trip blanks, equipment blanks, and field duplicates.

Data were carried through data validation as described in the SPEIM QAPP and data flags were assigned according to the SPEIM QAPP. These flags, and the reason for each flag, were entered into the electronic database and can be found in Table B-2 (located at the end of this attachment). Multiple flags are routinely applied to specific sample method/matrix/analyte combinations, but there is only one final flag. A final flag is applied to the data, and is the most conservative of the applied validation flags. The final flag also includes matrix and blank sample impacts.

The data flags are listed in the SPEIM QAPP and are defined as follows:

- J = Analyte was present but the reported value may not be accurate or precise (estimated).
- R = Analyte result was unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.
- U = Analyte was not detected at the specified detection limit.
- UJ = Analyte was not detected and the specified detection limit may not be accurate or precise (estimated).

## **FINDINGS**

The summaries of the data validation findings are contained in the following subsections and Table B-2.



## **Holding Times**

All holding-time criteria were met. No holding time flags were applied.

## **Calibration**

Initial and continuing calibrations were analyzed as required in every analytical batch and were in control. No calibration flags were applied.

## **Method Blanks**

Method blanks were analyzed at the required frequency. No method blank flags were applied.

## **Field Blanks**

Equipment blanks were collected and analyzed at the required frequency. No field or equipment blank flags were applied.

## **Field Duplicates**

Field duplicates were collected as required, and precision was acceptable. No field duplicate flags were applied.

## **Matrix Spike Samples**

Matrix spike/matrix spike duplicates were not required for these samples in accordance with the SPEIM QAPP.

## **Surrogates**

Surrogate recoveries met method SPEIM QAPP criteria overall. There was one detected sample with Surrogate recovery greater than upper limit for method E504.1. There were two samples (one detected and one not detected) with surrogate recovery less than lower limit for method E504.1. The detected results were qualified as estimated values and flagged "J" while non-detected results were qualified as estimated values and flagged "UJ".

## **Laboratory Control Samples**

Laboratory control sample/laboratory control sample duplicates (LCS/LCSD) were analyzed as required were in control. No LCS flags were applied.

## **Confirmation Results**

Confirmation samples were analyzed as required by method E504.1. No confirmation flags were applied.

## **Chain of Custody**

No chain of custody anomalies were noted in the review.

## **Overall Assessment**

The goal of this assessment is to demonstrate that a sufficient number of representative samples were collected and the resulting analytical data can be used to support the decision-making process. The procedures for assessing the precision, accuracy, representativeness, completeness, and comparability parameters (PARCC) are addressed in the SPEIM QAPP. The following summary highlights the PARCC findings for the above-defined events:

1. The completeness goal for valid usable data is 95 percent for aqueous samples. Completeness for aqueous samples was 100 percent.
2. The routinely acceptable performance of field and laboratory QC indicators (field duplicates, field blanks, laboratory blanks, surrogate spikes, LCS, and calibrations) shows that the precision and accuracy of the data met project objectives.
3. Sample results are representative and comparable to field conditions and past historical data because the field sampling and laboratory analyses were performed using standardized and documented procedures as defined in project documents. In addition, all results were reported with industry standard units.

**Table B-2  
Validation Flags<sup>a</sup>**

Field ID	Method	Analyte	Final Result (µg/L)	Final Flag	Reason
CHPN0043B-T0512DIF	E504.1	1,2-Dibromoethane (EDB)	0.008	J	Sur<LCL
CHPN01010-T0512	E504.1	1,2-Dibromoethane (EDB)	0.005	UJ	Sur<LCL
CHTD02001-M0612	E504.1	1,2-Dibromoethane (EDB)	0.037	J	Sur>UCL

<sup>a</sup>Field samples and field duplicates only.

Table sorted by Reason, Analyte and Field ID.

Key:

J = estimated

Sur<LCL = Surrogate recovery less than lower limit

Sur>UCL = Surrogate recovery greater than upper limit

UJ = estimated non-detection

µg/L = micrograms per liter

**Attachment B**  
**Analytical Laboratory Results, January - December 2012**  
**Fuel Spill-1 2012 Summary Letter Report**

Location	Date	Sample ID	Depth	Type	Matrix	Test	Prep	Analyte	Result	DL	RL	Units	Qual
36EW0001	1/26/2012	CHTD00001-O0212	123.74	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.011	0.005	0.01	µg/L	
36EW0001	4/16/2012	CHTD00001-O0412	123.74	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.031	0.005	0.01	µg/L	
36EW0005	5/11/2012	CHPN00005-T0512	181	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.01	0.005	0.01	µg/L	
36EW0005	12/18/2012	CHPN00005-S1212	181	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36EW0011	5/11/2012	CHPN00011-T0512	213.17	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.052	0.005	0.01	µg/L	
36EW0011	12/18/2012	CHPN00011-S1212	213.17	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.028	0.005	0.01	µg/L	
36EW4020	5/21/2012	CHPN04020-T0512DIF	18.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36EW4084	5/21/2012	CHPN04084-T0512DIF	19	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW0131A	5/1/2012	CHPN0131A-T0512DIF	182.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	BRL	0.005	0.01	µg/L	J
36MW0131B	5/1/2012	CHPN0131B-T0512DIF	136.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW0131C	5/1/2012	CHPN0131C-T0512DIF	87.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW0132A	5/1/2012	CHPN0132A-T0512DIF	187.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW0132A	6/29/2012	CHPN00132A-O0712DIF	187.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW0132A	10/3/2012	CHPN00132A-O1012	187.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW0132B	5/1/2012	CHPN0132B-T0512DIF	137.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW0132B	6/29/2012	CHPN00132B-O0712DIF	137.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW0132B	10/3/2012	CHPN00132B-O1012	137.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW0132C	5/1/2012	CHPN0132C-T0512DIF	80.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	BRL	0.005	0.01	µg/L	J
36MW0133	5/4/2012	CHPN00133-T0512DIF	57.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW0135	5/4/2012	CHPN00135-T0512DIF	177.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW0136	5/1/2012	CHPN00136-T0512DIF	147.74	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW0137	5/4/2012	CHPN00137-T0512DIF	108.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW0140	5/4/2012	CHPN00140-T0512DIF	137.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW0143	5/4/2012	CHPN00143-T0512DIF	167.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW0501	5/7/2012	CHPN00501-T0512DIF	147.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW0503A	5/7/2012	CHPN0503A-T0512DIF	192.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.029	0.005	0.01	µg/L	
36MW0503B	5/7/2012	CHPN0503B-T0512DIF	147.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW0503C	5/7/2012	CHPN0503C-T0512DIF	117.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW0504	5/7/2012	CHPN00504-T0512DIF	179.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1001A	5/21/2012	CHPN0001A-T0512DIF	147.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1001B	5/21/2012	CHPN0001B-T0512DIF	97.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1003A	5/21/2012	CHPN0003A-T0512DIF	151.6	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1010A	5/7/2012	CHPN0010A-T0512DIF	225.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1010B	5/7/2012	CHPN0010B-T0512DIF	162.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1010C	5/7/2012	CHPN0010C-T0512DIF	83	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1011A	5/4/2012	CHPN0011A-T0512DIF	97.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1011B	5/4/2012	CHPN0011B-T0512DIF	22.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1012A	5/21/2012	CHPN0012A-T0512DIF	146.6	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1012B	5/21/2012	CHPN0012B-T0512DIF	75.4	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.01	0.005	0.01	µg/L	
36MW1012C	5/21/2012	CHPN0012C-T0512DIF	20.1	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1014A	5/21/2012	CHPN0014A-T0512DIF	96	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1014B	5/21/2012	CHPN0014B-T0512DIF	20.6	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1036A	5/21/2012	CHPN0036A-T0512DIF	260.48	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1036B	5/21/2012	CHPN0036B-T0512DIF	221.4	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U

**Attachment B**  
**Analytical Laboratory Results, January - December 2012**  
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Location	Date	Sample ID	Depth	Type	Matrix	Test	Prep	Analyte	Result	DL	RL	Units	Qual
36MW1036C	5/21/2012	CHPN0036C-T0512DIF	172.63	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1038A	5/3/2012	CHPN0038A-T0512DIF	242.15	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1038B	5/3/2012	CHPN0038B-T0512DIF	201.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1038C	5/3/2012	CHPN0038C-T0512DIF	91.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1039A	5/7/2012	CHPN0039A-T0512DIF	250.95	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1039B	5/7/2012	CHPN0039B-T0512DIF	191.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1039C	5/7/2012	CHPN0039C-T0512DIF	141.44	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1040A	5/3/2012	CHPN0040A-T0512DIF	216.12	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.013	0.005	0.01	µg/L	
36MW1040B	5/3/2012	CHPN0040B-T0512DIF	130.9	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1041A	5/3/2012	CHPN1041A-T0512DIF	221.5	FD1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.108	0.005	0.01	µg/L	
36MW1041A	5/3/2012	CHPN0041A-T0512DIF	221.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.102	0.005	0.01	µg/L	
36MW1041B	5/3/2012	CHPN0041B-T0512DIF	152.15	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1041C	5/3/2012	CHPN0041C-T0512DIF	132.25	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1043A	5/7/2012	CHPN0043A-T0512DIF	252.38	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1043B	5/7/2012	CHPN0043B-T0512DIF	162.4	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	BRL	0.005	0.01	µg/L	J
36MW1045A	5/14/2012	CHPN0045A-T0512	182.69	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1045A	7/2/2012	CHPN01045A-O0712	182.69	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	BRL	0.005	0.01	µg/L	J
36MW1045A	10/3/2012	CHPN01045A-O1012	182.69	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1045B	5/14/2012	CHPN0045B-T0512	117.69	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1045B	7/2/2012	CHPN01045B-O0712	117.69	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36MW1045B	10/3/2012	CHPN01045B-O1012	117.69	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36PLT02001	1/30/2012	CHTD02001-M0212	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.04	0.005	0.01	µg/L	
36PLT02001	2/27/2012	CHTD02001-M0312	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.036	0.005	0.01	µg/L	
36PLT02001	3/27/2012	CHTD02001-M0412	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.041	0.005	0.01	µg/L	
36PLT02001	4/26/2012	CHTD02001-M0512	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.033	0.005	0.01	µg/L	
36PLT02001	5/29/2012	CHTD02001-M0612	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.037	0.005	0.01	µg/L	J
36PLT02001	6/26/2012	CHTD02001-M0712	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.039	0.005	0.01	µg/L	
36PLT02001	8/28/2012	CHTD02001-M0912	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.035	0.005	0.01	µg/L	
36PLT02001	9/27/2012	CHTD02001-M1012	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.031	0.005	0.01	µg/L	
36PLT02001	10/25/2012	CHTD02001-M1112	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.026	0.005	0.01	µg/L	
36PLT02001	11/28/2012	CHTD02001-M1212	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.026	0.005	0.01	µg/L	
36PLT02001	12/26/2012	CHTD02001-M0113	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.022	0.005	0.01	µg/L	
36PLT02002	1/30/2012	CHTD02002-M0212	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.011	0.005	0.01	µg/L	
36PLT02003	2/27/2012	CHTD02003-M0312	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36PLT02003	3/27/2012	CHTD02003-M0412	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	BRL	0.005	0.01	µg/L	J
36PLT02003	4/26/2012	CHTD02003-M0512	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36PLT02003	5/29/2012	CHTD02003-M0612	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	BRL	0.005	0.01	µg/L	J
36PLT02003	6/26/2012	CHTD02003-M0712	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.013	0.005	0.01	µg/L	
36PLT02004	8/28/2012	CHTD02004-M0912	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36PLT02004	9/27/2012	CHTD02004-M1012	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36PLT02004	10/25/2012	CHTD02004-M1112	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36PLT02004	11/28/2012	CHTD02004-M1212	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	BRL	0.005	0.01	µg/L	J
36PLT02004	12/26/2012	CHTD02004-M0113	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36PLT02005	1/30/2012	CHTD02005-M0212	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U

**Attachment B**  
**Analytical Laboratory Results, January - December 2012**  
**Fuel Spill-1 2012 Summary Letter Report**

Location	Date	Sample ID	Depth	Type	Matrix	Test	Prep	Analyte	Result	DL	RL	Units	Qual
36PLT02005	2/27/2012	CHTD02005-M0312	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36PLT02005	3/27/2012	CHTD02005-M0412	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36PLT02005	4/26/2012	CHTD02005-M0512	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36PLT02005	5/29/2012	CHTD02005-M0612	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36PLT02005	6/26/2012	CHTD02005-M0712	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36PLT02005	8/28/2012	CHTD02005-M0912	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36PLT02005	9/27/2012	CHTD02005-M1012	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36PLT02005	10/25/2012	CHTD02005-M1112	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36PLT02005	11/28/2012	CHTD02005-M1212	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36PLT02005	12/26/2012	CHTD02005-M0113	N/A	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36PZ1001	5/22/2012	CHPN01001-T0512	4.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36PZ1002A	5/22/2012	CHPN0002A-T0512	127.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36PZ1002B	5/22/2012	CHPN0002B-T0512	4.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36PZ1003	5/22/2012	CHPN01003-T0512	4.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
36PZ1010	5/7/2012	CHPN01010-T0512	27.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	UJ
36SW0019	8/15/2012	CHPN00019-A0812	N/A	N1	WS	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U

Data Source: AFCEC, February 2013, MMR-AFCEC Data Warehouse

Key:

BRL = below reporting limit	RL = reporting limit
DL = detection limit	U = undetected
FD1 = field duplicate	UJ = estimated non-detection
J = estimated value	WG = groundwater
N1 = native sample	WW = wastewater
N/A = not applicable	WS = surface water
ND = not detected	µg/L = micrograms per liter

## **ATTACHMENT C**


### **FS-1 Project Notes**


**FS-1 2012 Triennial SPEIM Data Presentation, Network Optimization,  
and Supplemental Monitoring Results Project Note**

**437075-SPEIM-FS1-PRJNOT-001**

**2012 FS-1 Extraction, Treatment, and Discharge System Optimization Project Note**


**420005-SPEIM-FS1-PRJNOT-001**

  <b>AFCEC</b> <b>SPEIM/LTM</b> <b>Otis ANG Base, Massachusetts</b> <b>Contract FA8903-08-D-8769</b>	<b>PROJECT NOTE</b>	TASK ORDER 0337
	DOCUMENT CONTROL NUMBER: <b>437075-SPEIM-FS1-PRJNOT-001</b>	PROJECT NO. 437075
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<b>CDRL B010</b>		


Confirmation Of: <input type="checkbox"/> Meeting <input type="checkbox"/> Change Notice <input checked="" type="checkbox"/> General Project Note	Date Held: 27 September 2012 and 28 November 2012 Location: Large IRP Conference Room Date Issued: 18 December 2012 Recorded By: Mark Hilyard
Subject: <b>FS-1 2012 TRIENNIAL SPEIM DATA PRESENTATION,          NETWORK OPTIMIZATION, AND SUPPLEMENTAL          MONITORING RESULTS PROJECT NOTE</b>  <b>EPA OU-06</b>	Issued By: Nigel Tindall   <hr/> CH2M HILL PROJECT MANAGER

ITEM	REMARKS
<b>1.0</b>	<p><b>INTRODUCTION</b></p> <p>This project note summarizes the Fuel Spill-1 (FS-1) 2012 triennial data presentation, which included data collected for the FS-1 System Performance and Ecological Impact Monitoring (SPEIM) program between July 2011 and August 2012. The triennial data presentation also included an update on the supplemental groundwater monitoring completed through July 2012 at monitoring wells located downgradient of off-line extraction well 36EW0001 and an optimization of the SPEIM monitoring network. The data presented includes results from the following sampling events:</p> <ul style="list-style-type: none"> <li>• Annual sampling of 33 monitoring wells (May-2012)</li> <li>• Biennial sampling of 10 monitoring wells (May-2012)</li> <li>• Triennial sampling of 11 monitoring wells (May-2012)</li> <li>• Semiannual sampling of operational extraction wells (Dec-2011 and May-2012)</li> <li>• Monthly treatment plant sampling (Jul-11 through Jul-12)</li> <li>• Annual water sampling at Quashnet Bog (Aug-12)</li> <li>• Supplemental sampling at monitoring wells downgradient of 36EW0001 (Jul-2012)</li> </ul> <p>These data and the network optimization were presented to the regulatory agencies during the 27 September 2012 Technical Update meeting.</p> <p>This project note also documents an additional update to the supplemental sampling that was completed at monitoring wells downgradient of 36EW0001 in October 2012; the results of which were presented at the 28 November 2012 Technical Update meeting. The 27 September 2012 data presentation is included as <a href="#">Attachment A</a> and the 28 November 2012 supplemental sampling update is provided as <a href="#">Attachment B</a>.</p>




  <b>AFCEC</b> <b>SPEIM/LTM</b> Otis ANG Base, Massachusetts Contract FA8903-08-D-8769	<b>PROJECT NOTE</b>	TASK ORDER 0337
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ITEM	REMARKS
<b>2.0</b>	<p><b>BACKGROUND</b></p> <p>The FS-1 plume is detached from its source area and is defined as the extent of groundwater containing the contaminant of concern (COC), ethylene dibromide (EDB), at concentrations exceeding the Massachusetts Maximum Contaminant Level (MMCL) of 0.02 micrograms per liter (µg/L). The FS-1 EDB plume is being remediated through the operation of the FS-1 extraction, treatment, and discharge (ETD) system, which currently extracts contaminated groundwater via two extraction wells at a combined pumping rate of 425 gallons per minute (gpm). The source area for the FS-1 groundwater plume is located on base and the selected remedy is long term monitoring. Lead, thallium and toluene are COCs for the FS-1 source area groundwater. However, the source area groundwater is no longer sampled for toluene and thallium because toluene has not been detected at concentrations above the Maximum Contaminant Level of 1,000 µg/L since 1999 and thallium was not detected at source area groundwater monitoring wells during twelve sampling event completed between 2002 and 2005. The FS-1 source area groundwater is currently monitored for lead at two groundwater monitoring wells that are sampled on a biennial frequency and were last sampled in 2011.</p> <p>Analytical data for the FS-1 plume have been collected through the SPEIM program since startup of the ETD system in 1999. This program was developed to monitor plume changes and to ensure the effective operation of the Air Force Civil Engineer Center (AFCEC) groundwater remediation systems at the Massachusetts Military Reservation; monitoring networks are also evaluated and optimized through the SPEIM program. The current approved FS-1 SPEIM monitoring network, including analytical scope and methods, is presented in the <i>Comprehensive Long Term Monitoring Plan</i>, which is available upon request.</p>
<b>3.0</b>	<p><b>RESULTS</b></p> <p><u>SPEIM Monitoring (27 September 2012 Technical Update Meeting)</u></p> <p>Analytical results and concentration trend graphs were presented for select wells that are monitored throughout the FS-1 plume (<a href="#">Attachment A</a>). Cross-sectional representations of the FS-1 plume and EDB trend plots for groundwater and surface water were updated using the most recent data. An overview of the ETD system performance for the reporting period was also presented by providing treatment plant influent concentration trends, EDB mass removal, volume of groundwater treated, frequency of carbon exchanges, extraction well operational rates, and estimated reductions in air emissions that have resulted from AFCEC green power purchases and operation of the three AFCEC-owned wind turbines.</p> <p>The data collected through the SPEIM program indicate that the remedial goals for the FS-1 ETD system are being met and that plume cleanup is progressing as predicted in the <i>Final FS-1 Wellfield Design Report</i> (AFCEE 2001). North of 36EW0011, concentrations of EDB greater than the MMCL were reported at only two monitoring wells (36MW0503A and 36MW1041A; Figure 2 of <a href="#">Attachment A</a>), indicating that both the width of the plume has decreased and the shallower portions of the aquifer have cleaned up. South of 36EW0011, concentrations of EDB have decreased significantly at all monitoring wells since system startup (Figure 3,</p>

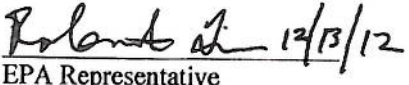
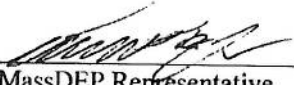
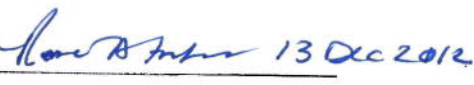
  <b>AFCEC</b> <b>SPEIM/LTM</b> <b>Otis ANG Base, Massachusetts</b> <b>Contract FA8903-08-D-8769</b>	<b>PROJECT NOTE</b>		TASK ORDER 0337
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	<p><a href="#">Attachment A</a>). In fact, EDB was not detected at 32 out of 35 monitoring wells located south of 36EW0011 and detections at the remaining three monitoring wells were at or below the reporting limit (BRL) of 0.01 µg/L (Figure 2, <a href="#">Attachment A</a>). No EDB was detected at surface water monitoring location 36SW0019 in 2012 (Figure 7, <a href="#">Attachment A</a>).</p> <p>Plant influent monitoring data indicate that the northernmost extraction well, 36EW0011, is capturing the most mass. Due to a significant reduction in the EDB plume volume concentration south of 36EW0011, the mass removal efficiency of 36EW0005, and particularly 36EW0001, has decreased with time (Figures 8 and 9, <a href="#">Attachment A</a>). Therefore, a field data gap investigation was initiated in 2010 and influent flow testing at 36EW0001 was conducted in 2011 to collect data in support of an optimization of this extraction well.</p> <p><u>Optimization of 36EW0001</u> (28 November 2012 Technical Update Meeting)</p> <p>On 08 May 2012, extraction well 36EW0001 shut down due to a faulty variable frequency drive. SPEIM data and flow testing completed at 36EW0001 prior to May 2012 indicated that EDB concentrations greater than the MMCL, if present, were likely deep in the aquifer and very limited in extent in the area near 36EW0001. Therefore, in July 2012, AFCEC proposed, and the regulatory agencies agreed, to leave 36EW0001 off on an interim basis and sample supplemental monitoring wells (36MW0132A,B and 36MW1045A,B), which are located near 36EW0001 for a minimum of two quarters. It was agreed that the need to restart 36EW0001 and/or the frequency of continued monitoring at the four downgradient monitoring wells would be made in consultation with the regulatory agencies based on a review of the data collected through October 2012.</p> <p>Sampling of these supplemental monitoring wells was completed in July 2012 and again in October 2012. With the exception of BRL detection of EDB (0.005 µg/L) at 36MW1045A in July 2012, no EDB has been detected at monitoring wells located downgradient or crossgradient of 36EW0001 during two quarterly rounds of post-shutdown monitoring. These monitoring wells are located approximately 50 to 80 feet from 36EW0001. The EDB plume, if present at 36EW0001, is expected to have migrated this distance by now.</p> <p><u>SPEIM Network Optimization</u> (27 September 2012 Technical Update Meeting)</p> <p>Because the footprint of FS-1 has decreased significantly since the last network optimization (2006), many of the monitoring wells are now located outside the plume footprint. Therefore, a spatial and temporal analysis for each monitoring well was completed against the current plume boundary with the continued goal to collect data to support plume and ETD system performance monitoring, as well as verifying groundwater conditions downgradient of the plume. The following network optimizations were proposed:</p> <ul style="list-style-type: none"> <li>• Discontinue monitoring at 20 wells that are now located outside or above the plume due to multiple rounds of no EDB detections and/or redundancy with other well screens.</li> <li>• Discontinue monitoring at eight wells that are located shallow in the aquifer at the edge of the bogs due to multiple rounds of no EDB detections.</li> </ul>

  <b>AFCEC</b> <b>SPEIM/LTM</b> Otis ANG Base, Massachusetts Contract FA8903-08-D-8769	<b>PROJECT NOTE</b>	TASK ORDER 0337
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ITEM	REMARKS
	<ul style="list-style-type: none"> <li>In-Plume and leading edge monitoring wells will be monitored annually (with the exception of any supplemental sampling of the monitoring wells located near 36EW0001).</li> <li>Trailing edge monitoring wells will be sampled biennially (next sampling event in 2014).</li> <li>Sampling for total lead at the source area monitoring wells (lead) will remain at a biennial frequency; however, the next sampling event will be pushed back one year to 2014 to coincide with the EDB biennial monitoring event.</li> </ul>
<b>4.0</b>	<p><b>CONCLUSIONS/RECOMMENDATIONS</b></p> <p><u>2012 Triennial SPEIM Data Presentation</u> (27 September Technical Update Meeting)</p> <ul style="list-style-type: none"> <li>SPEIM groundwater monitoring data collected in 2012 continue to support the current FS-1 conceptual site model. <ul style="list-style-type: none"> <li>Most of the remaining plume mass is located upgradient of 36EW0011. Maximum EDB concentrations were reported at monitoring wells that are located to the north of 36EW0011 (0.029 µg/L at 36MW0503A and 0.102 µg/L at 36MW1041A).</li> <li>EDB concentrations and the plume footprint near 36EW0005 and 36EW0001 have decreased significantly. EDB influent concentrations at 36EW0005 have decreased to below MMCL and no EDB was detected in groundwater monitoring wells located in vicinity of 36EW0005. No EDB was detected in influent concentrations at 36EW0001 under steady-state operating conditions. EDB has been detected immediately upon startup after a rest period, but concentrations quickly decline to nondetect (ND).</li> <li>The concentrations of EDB in surface water at 36SW0019 were ND in 2012.</li> </ul> </li> <li>No change to the FS-1 Land Use Control boundary is warranted at this time.</li> <li>Many of the wells in the monitoring network for FS-1 are now outside the plume footprint.</li> <li>Adopt the optimized FS-1 SPEIM monitoring network.</li> </ul> <p><u>Supplemental Sampling of Monitoring Wells Located Near 36EW0001</u> (28 November 2012 Technical Update Meeting)</p> <ul style="list-style-type: none"> <li>Based upon a review of EDB results obtained from the supplemental sampling at monitoring wells located near 36EW0001 through October 2012, it was agreed that 36EW0001 will remain off and FS-1 ETD system will continue to operate under scenario 2012 Scenario 01 (36EW0001, 0 gpm; 36EW0005 175 gpm; 36EW0011; 250 gpm). The next sampling event at the four monitoring wells (36MW0132A,B and 36MW1045A,B) near 36EW0001 will be completed during the next annual FS-1 SPEIM sampling event (May 2013).</li> </ul>

 <b>CH2MHILL</b>  <b>AFCEC</b> <b>SPEIM/LTM</b> Otis ANG Base, Massachusetts Contract FA8903-08-D-8769	<b>PROJECT NOTE</b>		TASK ORDER 0337
			PROJECT NO. 437075
	DOCUMENT CONTROL NUMBER: 437075-SPEIM-FS1-PRJNOT-001 CDRL B010		PAGE 5 OF 5

ITEM	REMARKS
5.0	<b>REGULATOR COMMENTS/ACTION ITEMS</b>  No comments were received on the FS-1 2012 Triennial SPEIM Data Presentation and Network Optimization from the regulatory agencies at the 27 September 2012 Technical Update meeting. Concurrence with the optimized FS-1 SPEIM monitoring network was achieved via e-mail from MassDEP on 28 September 2012 and from EPA on 10 October 2012. No additional comments regarding the FS-1 SPEIM data presentation or the network optimization were received at a check-in completed during the 28 November 2012 Technical Update meeting.  No comments regarding the results and proposed path forward associated with the supplemental sampling of the four monitoring wells located near 36EW0001 were received during the 28 November 2012 Technical Update meeting.
6.0	<b>REFERENCE</b>  AFCEE (Air Force Center for Engineering and the Environment). 2001 (December). <i>Final Fuel Spill-1 Wellfield Design Report</i> . AFC-J23-35S19902-M23-0005. Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.
7.0	<b>REGULATOR CONCURRENCE</b>  Concurrence with the updated FS-1 EDB plume boundary, optimized SPEIM monitoring network (Table 2 of Attachment A) and proposed path forward regarding the operational status and monitoring for 36EW0001 is represented by the signatures below:  <div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="text-align: center;">             12/13/12            EPA Representative         </div> <div style="text-align: center;">             12/13/12            MassDEP Representative         </div> </div> <div style="text-align: center; margin-top: 20px;">             13 Dec 2012            AFCEC Project Manager         </div> <p>Note: The parties involved will retain the ability to modify the monitoring network or the recommended path forward for 36EW0001 based on field observations or other mutually agreeable technical justifications.</p>

**Attachments:**

- Attachment A: FS-1 2012 Triennial SPEIM Data Presentation and SPEIM Monitoring Network Optimization, 27 September 2012 Technical Update Meeting
- Attachment B: FS-1 Monitoring Downgradient of 36EW0001, 28 November 2012 Technical Update Meeting

## **ATTACHMENT A**

### **FS-1 2012 Triennial SPEIM Data Presentation and SPEIM Monitoring Network Optimization, 27 September 2012 Technical Update Meeting**

# **FS-1 2012 Triennial SPEIM Data Presentation and SPEIM Monitoring Network Optimization**

## **27 September 2012 Technical Update Meeting**

### **Presentation Overview**

- **Groundwater Sampling Results (Figure 1)**
  - 33 annual monitoring wells (May 2012)
  - 10 biennial monitoring wells (May 2012)
  - 11 triennial monitoring wells (May 2012)
- **Surface Water Sampling Results**
  - Annual Sampling at Quashnet Bog (August 2012)
- **ETD System Performance Monitoring** (July 2011 through July 2012)
- **Downgradient Monitoring of 36EW0001** (May 2012 and June 2012)
- **SPEIM Monitoring Network Optimization**
- **Recommendations/Path Forward**

# FS-1 2012 Triennial SPEIM Data Presentation

## Groundwater Highlights

### **EDB concentrations north of Grafton Pocknet Road (Figure 2)**

- Exceedances of EDB MMCL at two monitoring wells (36MW0503A and 36MW1041A)
  - 36MW503A decreased from 0.074 µg/L in 2010 to 0.029 µg/L in 2012
  - 36MW1041A decreased from 0.212 µg/L in 2011 to 0.102 µg/L in 2012
- Following wells remain ND
  - 36MW1036A,B,C
  - 36MW1038A,B,C
  - 36MW1039A,B,C
  - 36MW0501
  - 36MW0504
- 36MW1040A decreased from 0.023 µg/L in 2011 to 0.013 µg/L in 2012
- 36MW1043B decreased from 0.028 µg/L in 2009 to BRL in 2012



# **FS-1 2012 Triennial SPEIM Data Presentation**

## **Groundwater Highlights (cont.)**

### **EDB concentrations south of Grafton Pocknet Road (Figure 2)**

- No concentrations greater than the reporting limit of 0.01 µg/L detected at groundwater monitoring wells located south of Grafton Pocknet Road
  - BRL concentrations of EDB at 36MW0131A and 36MW0132C
  - 0.01 µg/L of EDB at 36MW1012A

### **EDB concentration trends throughout FS-1 (Figure 3)**

### **Updated cross-sections (Figures 4-6)**

## **Surface Water Results (Figure 7)**



# FS-1 2012 Triennial SPEIM Data Presentation

## ETD System Performance Monitoring (June 2011 through June 2012)

- Extraction well influent concentrations over time (Figures 8 and 9)
- Approximately 241 million gallons of groundwater treated by ETD system
- 0.072 lbs of EDB removed at the plant
  - 36EW0001: 0.002 lbs
  - 36EW0005: 0.01 lbs
  - 35EW0011: 0.059 lbs
- Two carbon exchanges
- Electricity usage and associated air emissions provided in Table 1
- 36EW0005 and 36EW0011 operated at approximately 96% of design rates
- 36EW0001 undergoing flow testing or was off for part of the reporting period

# FS-1 2012 Triennial SPEIM Data Presentation

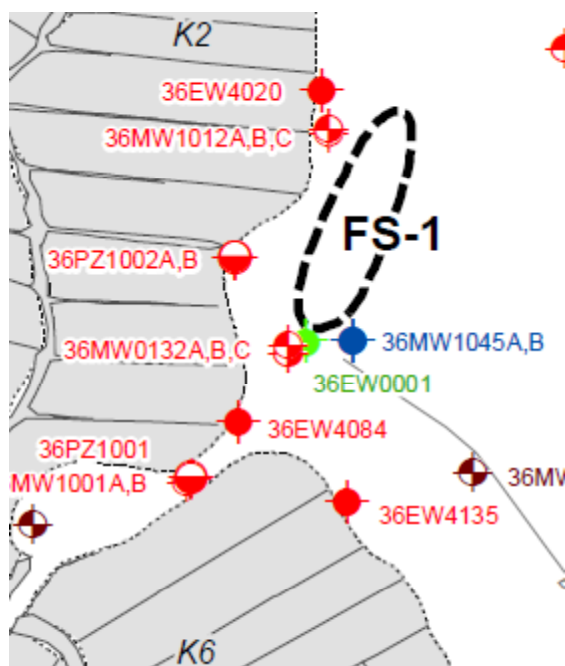
## ETD System Performance Monitoring (cont.)

- ETD system operated with 2007 Scenario 01 pumping configuration through November 2011
  - 90EW0001 - 90 gpm
  - 90EW0005 - 175 gpm
  - 90EW0011 - 250 gpm
- July 2011: Well screen at 36EW0001 shortened with packers
- November 2011: 36EW0001 reduced to 45 gpm for influent flow testing
- May 2012: 36EW0001 off due to a failed VFD
- Packer and flow testing results at 36EW0001, along with field data gap results, indicated that remaining EDB is likely to be deep in the aquifer and very limited in extent and are expected to attenuate at depth in the aquifer, therefore;
- Interim pumping configuration of 2012 Scenario 01 was implemented in July 2012 with increased monitoring for EDB downgradient of 36EW0001
  - 90EW0001 – 0 gpm
  - 90EW0005 – 175 gpm
  - 90EW0011 – 250 gpm

# FS-1 2012 Triennial SPEIM Data Presentation

## Groundwater Monitoring Downgradient of 36EW0001

- 05/08/12: 36EW0001 off during May 2012 SPEIM sampling event.
- First post-shutdown sampling event at downgradient monitoring wells (36MW0132A,B and 36MW1045A,B) completed 6/29 – 7/2/2011.
- Next downgradient sampling event scheduled for October 2012



Location	Analyte	Date	Result	DL	RL
			all units = µg/L		
36MW0132A	EDB	5/1/2012	ND	0.005	0.01
36MW0132A	EDB	6/29/2012	ND	0.005	0.011
36MW0132B	EDB	5/1/2012	ND	0.005	0.01
36MW0132B	EDB	6/29/2012	ND	0.005	0.01
36MW1045A	EDB	5/14/2012	ND	0.005	0.01
36MW1045A	EDB	7/2/2012	0.005 J	0.005	0.01
36MW1045B	EDB	5/14/2012	ND	0.005	0.01
36MW1045B	EDB	7/2/2012	ND	0.005	0.01

- Shading signifies shutdown date for 36EW0001 (05/08/2012)

# FS-1 2012 Triennial SPEIM Data Presentation

## Conclusions

- SPEIM data collected between July 2011 and July 2012 continue to support the current FS-1 conceptual site model and remediation of the plume is progressing as predicted.
- Plume footprint continues to contract in the aquifer toward extraction wells.
  - EDB concentrations and plume footprint near 36EW0001 and 36EW0005 have decreased significantly since system startup.
  - Most of the remaining plume mass is located upgradient of 36EW0011.
- No changes to FS-1 LUC boundary at this time (Figure 10).
- Detections of EDB in surface water at 36SW0019 are decreasing and are expected to continue to decrease.
- No EDB was detected at concentrations above the reporting limit at monitoring wells located downgradient of 36EW0001 during the first round of post-shutdown monitoring.
- Many monitoring wells are located well outside the current plume boundary, therefore, the SPEIM monitoring network should be optimized.

# FS-1 2012 Triennial SPEIM Data Presentation

## Groundwater Monitoring Network Optimization (Figure 11, Tables 2 and 3)

- Discontinue monitoring at 20 wells located outside or above the plume due to multiple rounds of no EDB detections and or redundancy with other well screens.
- Discontinue monitoring at 8 wells that are located shallow in the aquifer at edge of bogs due to multiple rounds of no EDB detections.
- Operating extraction wells will remain semiannual.
- In-plume and leading edge plume boundary wells will be monitored annually (next event will be 2013).
- Trailing edge monitoring wells will be sampled biennially (next sampling event in 2014).
- Source area monitoring wells will remain at a biennial frequency (next sampling event pushed out to 2014 to coincide with EDB biennial monitoring event).
- Monitoring reduced from approximately 48 samples to 30 samples on an annualized basis.

# FS-1 2012 Triennial SPEIM Data Presentation

## Recommendations/Path forward

- Continue to operate FS-1 ETD system using interim pumping configuration, 2012 Scenario 01.
  - Next sampling event downgradient of 36EW0001 is scheduled for October 2013
    - Results will be discussed at a future Technical Update meeting, and
    - Operational status of 36EW0001 and sampling frequency for monitoring wells downgradient of 36EW0001 may be finalized at that time
- Adopt revised FS-1 plume boundary.
- Implement optimized SPEIM chemical monitoring network.
  - Next semiannual sampling event is scheduled for December 2012 (extraction wells)
  - Next annual event scheduled for June 2013 (22 monitoring wells)
  - Next biennial event (lead and EDB) scheduled for June 2014 (9 monitoring wells)
- Continue with planned FS-1 private well verification survey in support of the Land Use Controls program.

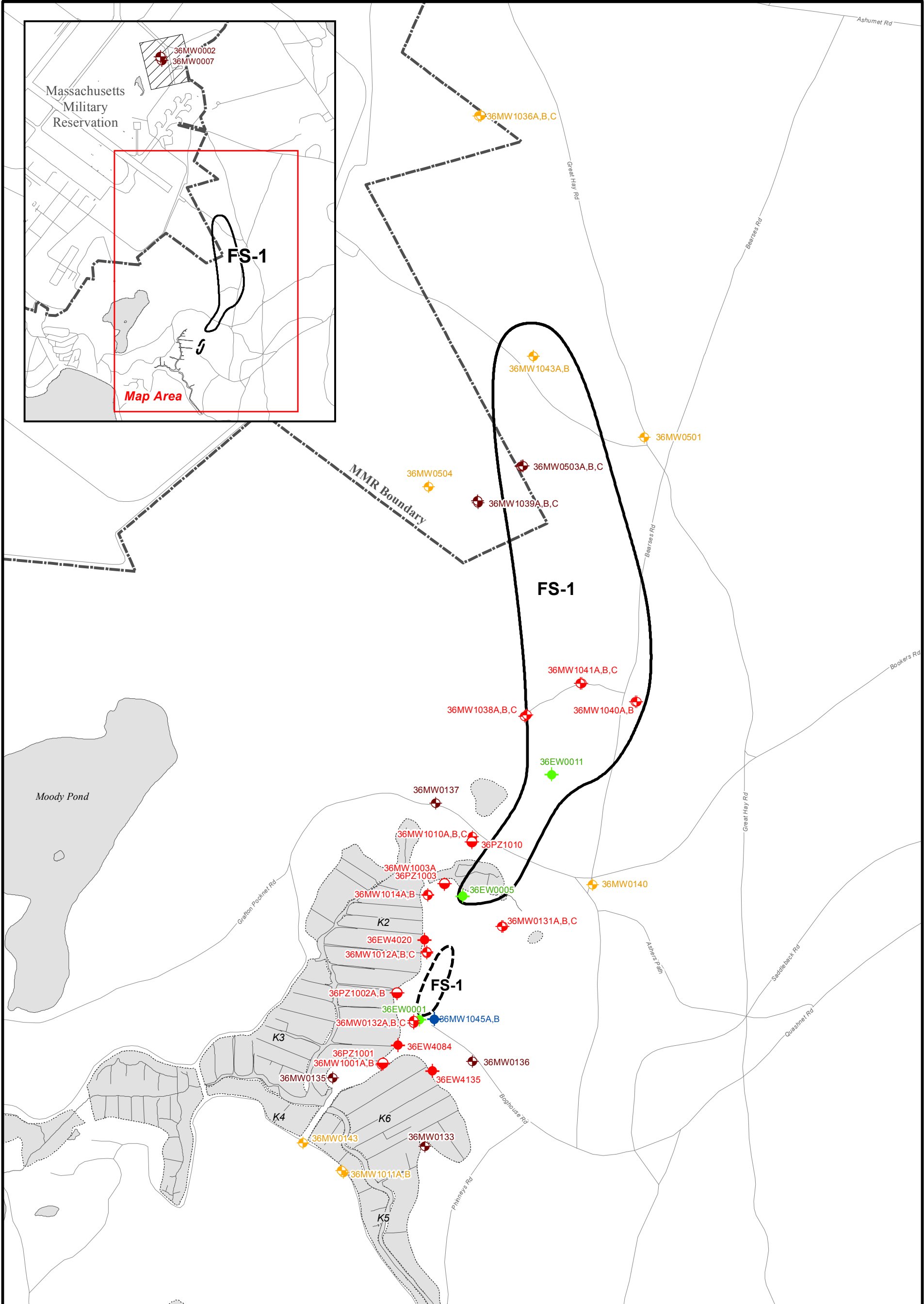
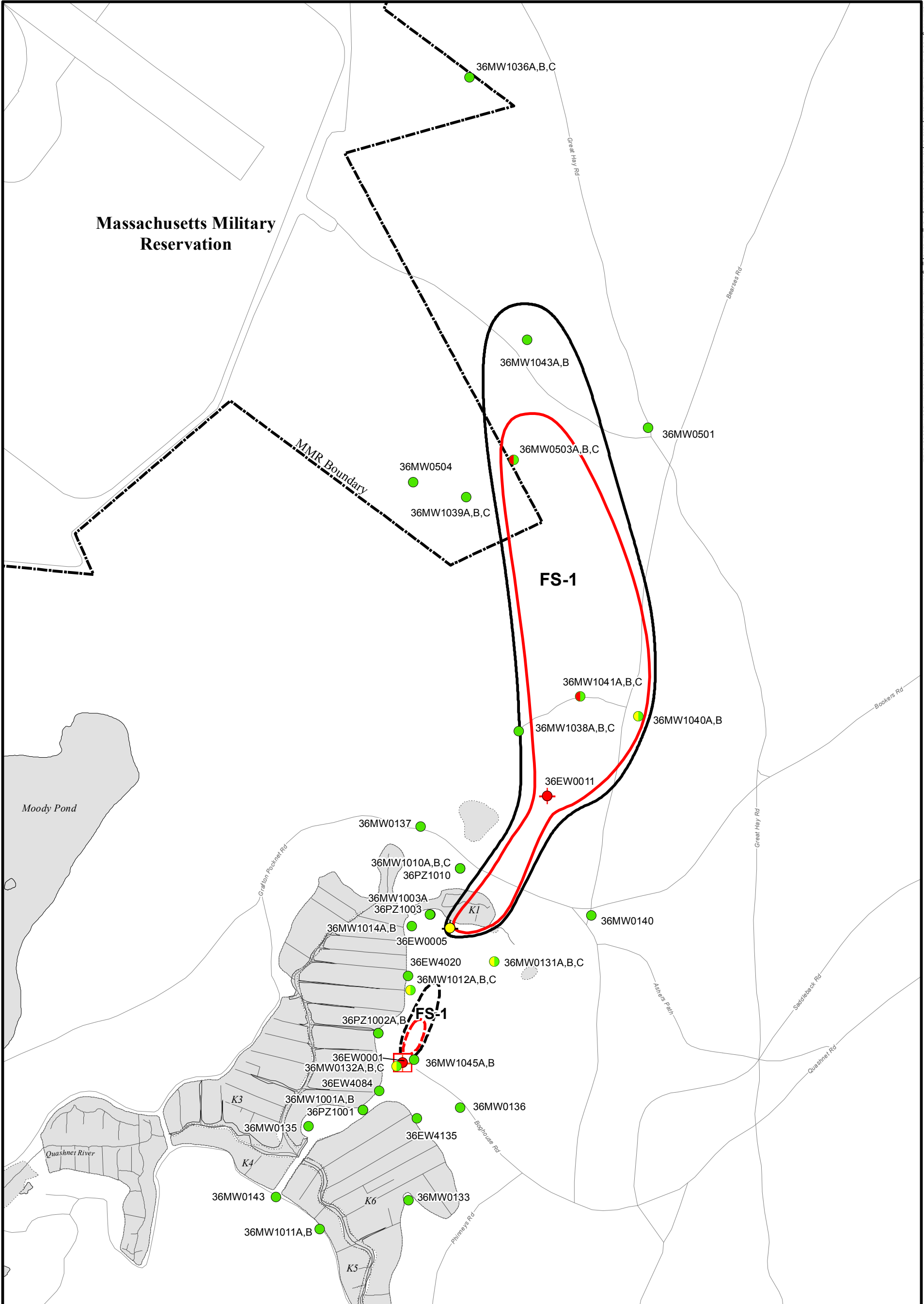


FIGURE 1

**FS-1 SPEIM GROUNDWATER  
CHEMICAL MONITORING NETWORK**  
AFCEE - Massachusetts Military Reservation  
27 September 2012 Technical Update Meeting



**Legend**

- 2011 Plume Boundary (Dashed Where Inferred)
- 2012 Plume Boundary (Dashed Where Inferred)
- Massachusetts Military Reservation Boundary
- Bog/Wetland
- Extraction Well (On)



Extraction Well (Off)

**Contaminant Detections:**

- No Detection
- Detection Below or at MMCL
- Detection Above MMCL

Data Source: AFCEE, August 2012, MMR-AFCEE Data Warehouse  
MMR Boundary from Massachusetts Air National Guard 2011



0 240 480 Feet

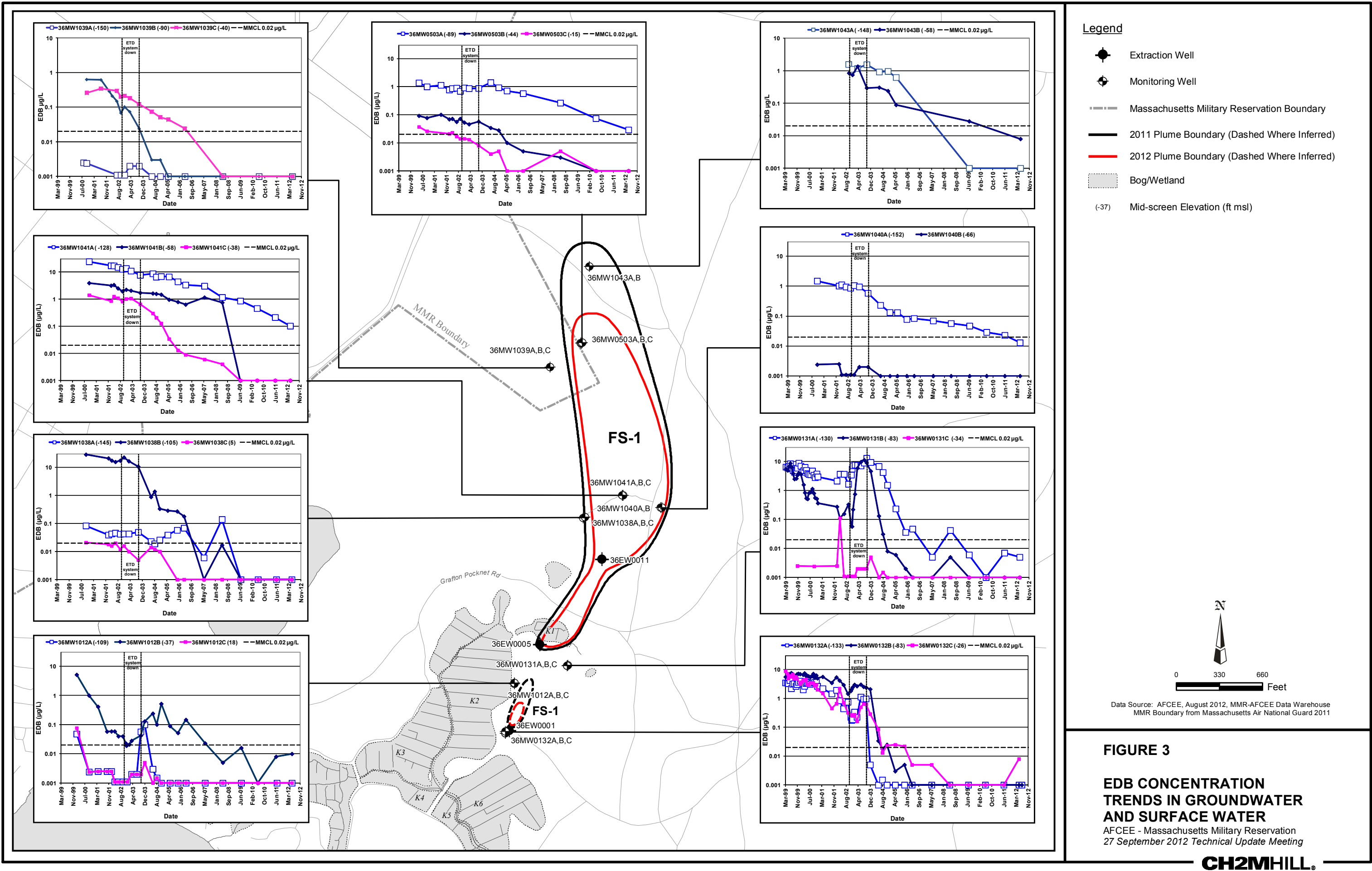
**FIGURE 2**

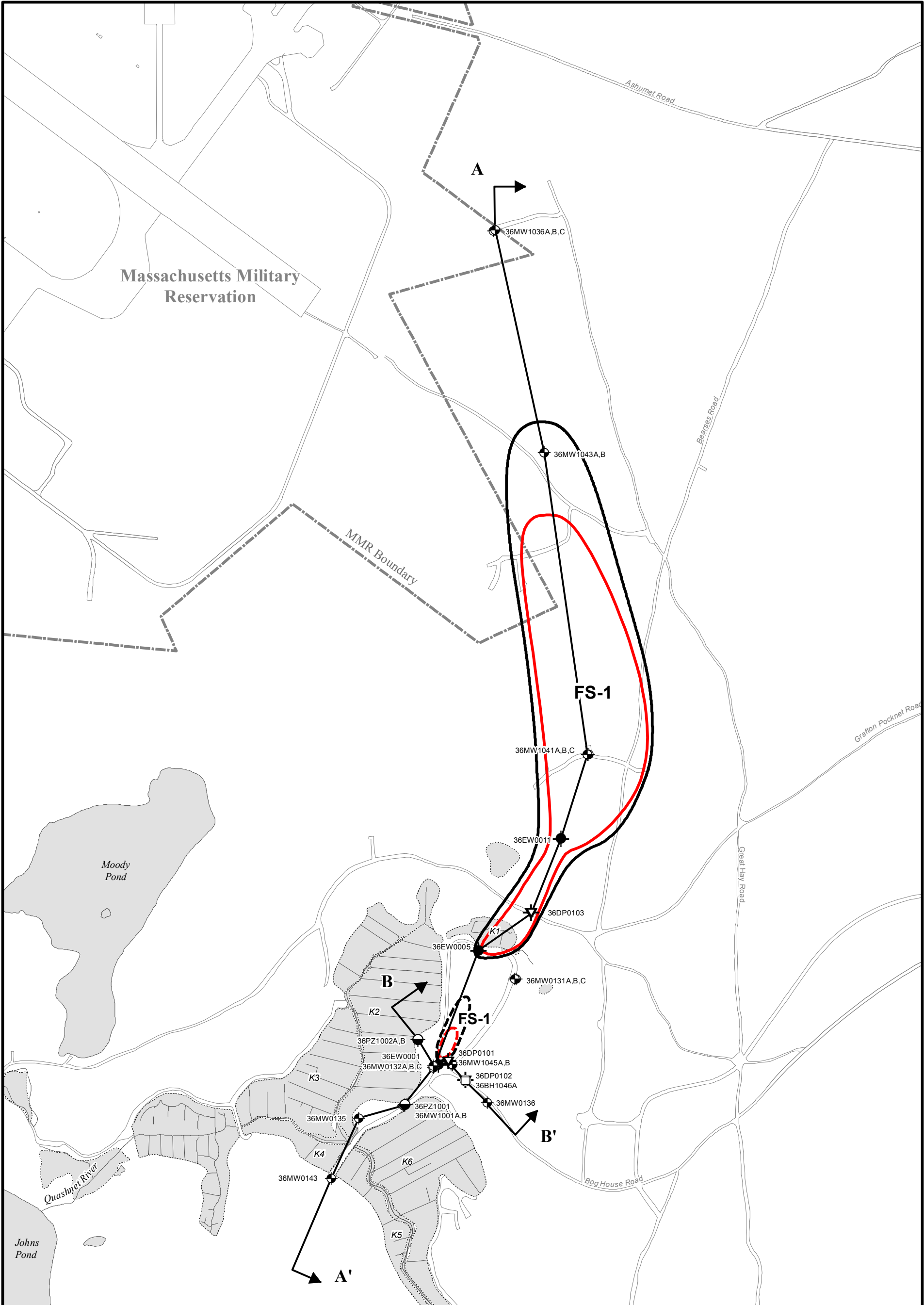
**FS-1 2011 ETHYLENE DIBROMIDE DETECTIONS IN GROUNDWATER**

AFCEE - Massachusetts Military Reservation  
27 September 2012 Technical Update Meeting

**CH2MHILL.**



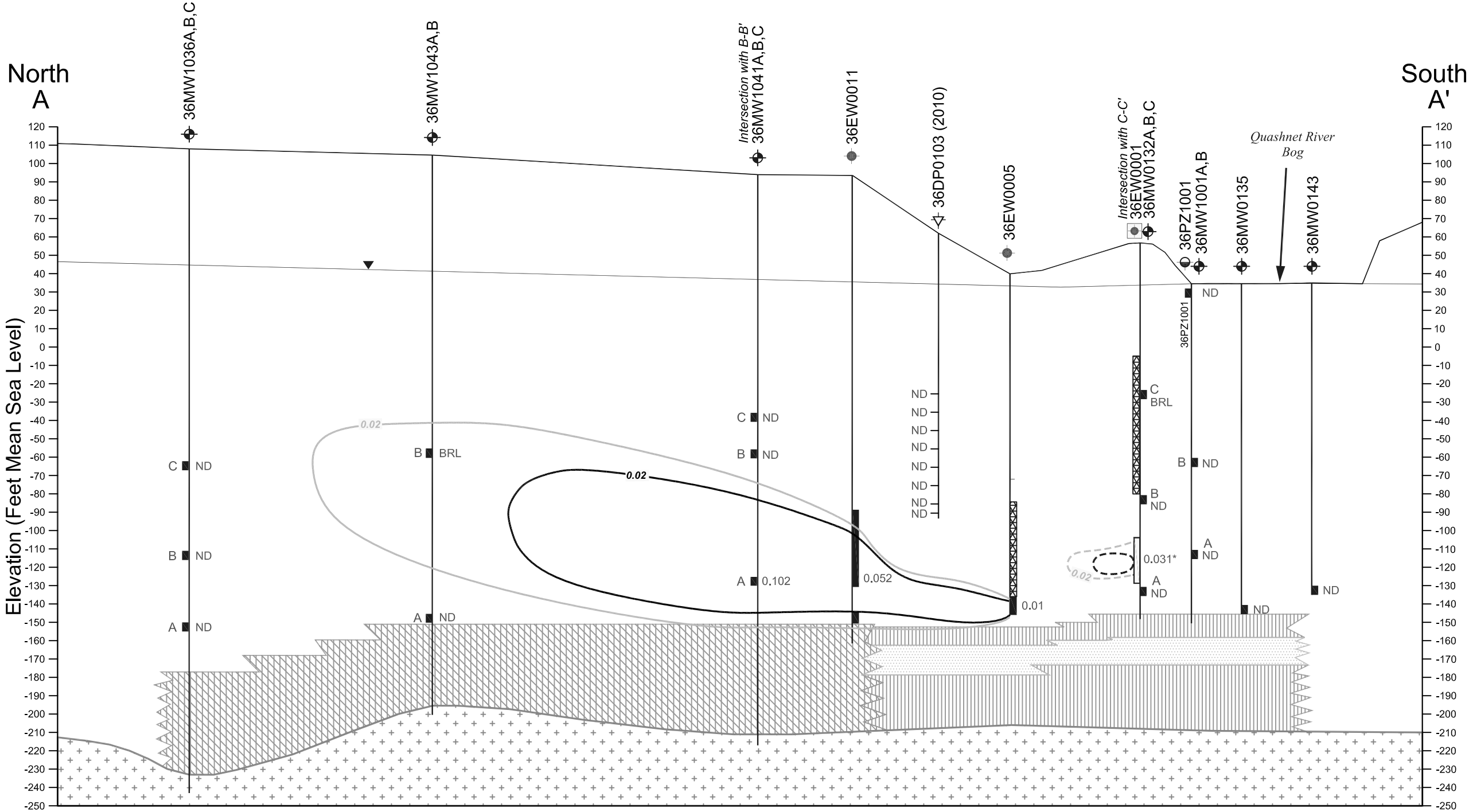




**FIGURE 4**

**FS-1 EDB PLUME AND LOCATION OF CROSS-SECTION LINES**

AFCEE - Massachusetts Military Reservation  
27 September 2012 Technical Update Meeting



Legend

- |                       |   |   |           |                        |
|-----------------------|---|---|-----------|------------------------|
| Monitoring Well       | Direct Push   | Well Screen   | Clay      | Bedrock                |
| Piezometer            | Water Table   | ND Nondetect  | Silt      | Silty Clay             |
| Extraction Well (On)  | Former EDB Isoconcentration Contour (Dashed Where Inferred) | Vertical Profile Results (06/10)                        | Fine Sand | Screen Closed (Packer) |
| Extraction Well (Off) | 2012 EDB Isoconcentration Contour (Dashed Where Inferred)   | EDB Result from May 2012, unless otherwise noted (µg/L) |           |                        |
- Data Source: August 2012, AFCEE, MMR-AFCEE Data Warehouse
- \*Sample collected immediately upon start-up of well after a one-week rest period.

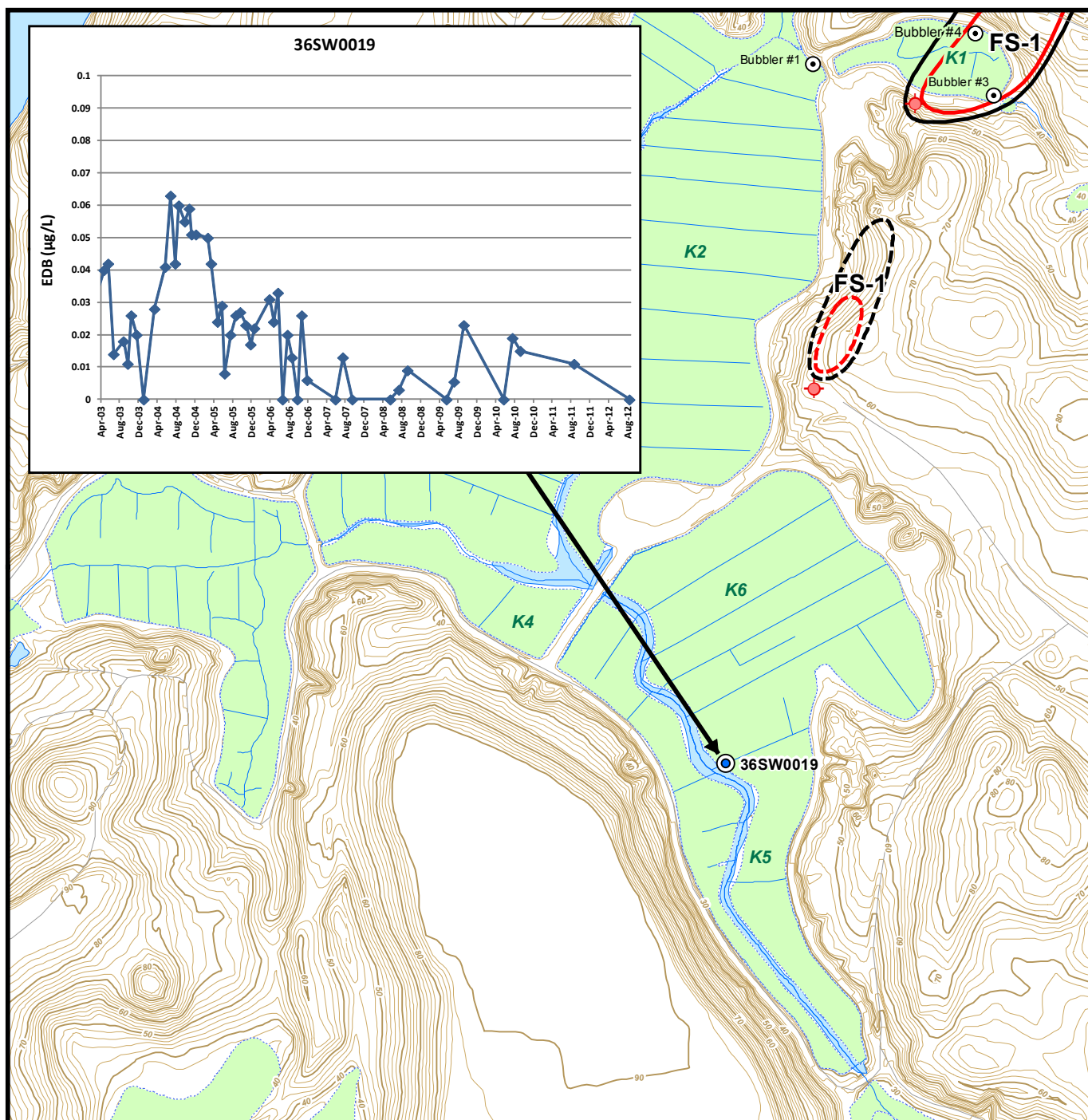


**FIGURE 5**  
**FS-1 CROSS-SECTION A-A'**  
AFCEE - Massachusetts Military Reservation  
27 September 2012 Technical Update Meeting

### FIGURE 6

**FS-1 CROSS-SECTION B-B'**

AFCEE - Massachusetts Military Reservation  
27 September 2012 Technical Update Meeting

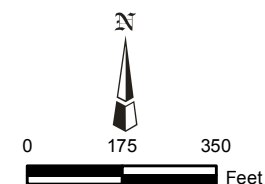


### Legend

- Bog/Wetland
- ⊙ Surface Water Sampling Location
- ⊙ Outflow Bubbler
- ⊙ Extraction Well
- Terrain Contour (2' Interval)
- 2011 Plume Boundary (Dashed Where Inferred)
- 2012 Plume Boundary (Dashed Where Inferred)

### Sampling Frequency:

- Annual (August)



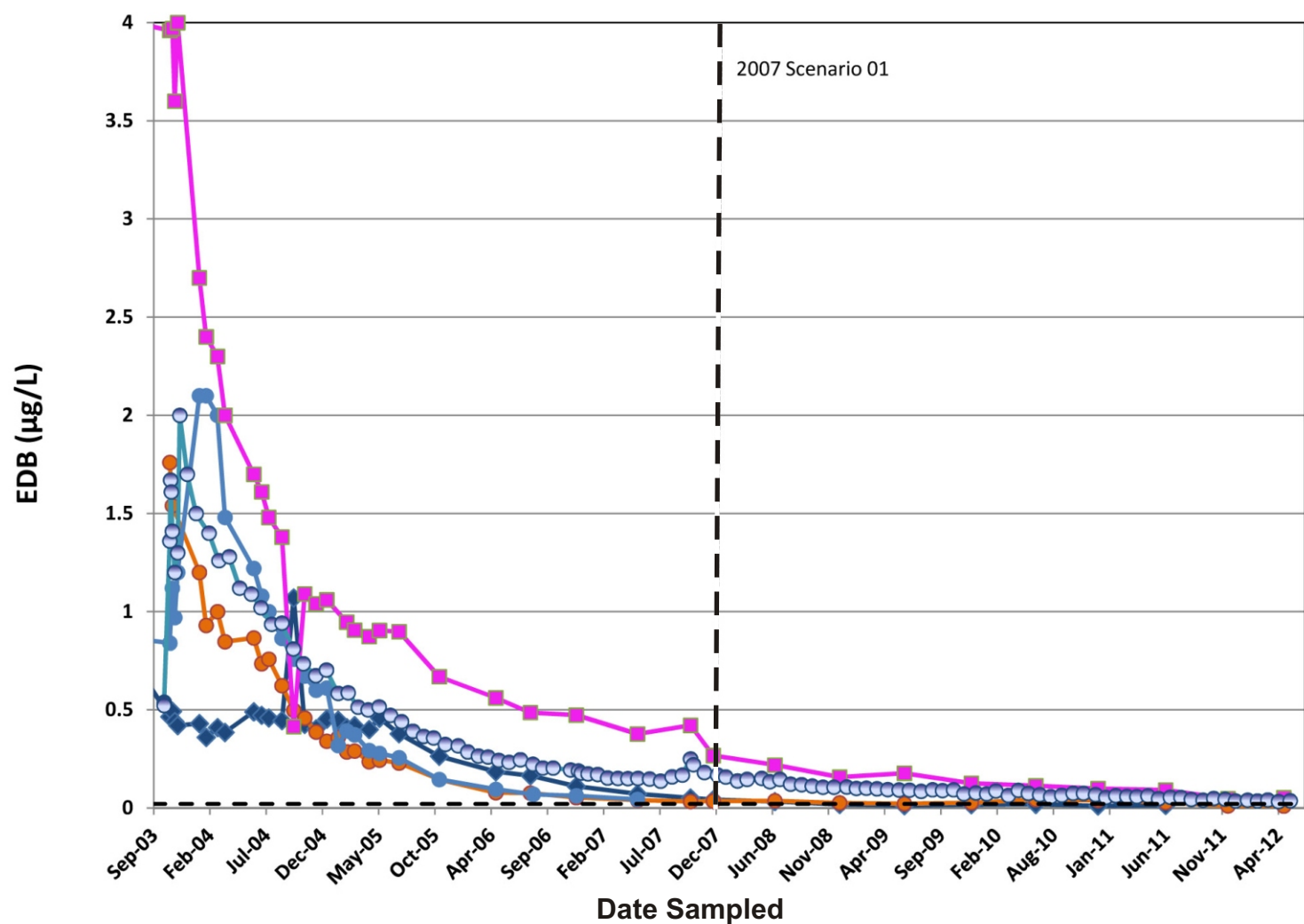
Data Source: AFCEE, MMR-AFCEE Data Warehouse

## FIGURE 7

### SURFACE WATER RESULTS

AFCEE - Massachusetts Military Reservation  
27 September 2012 Technical Update Meeting





Data Source: AFCEE, August 2012, MMR-AFCEE Data Warehouse

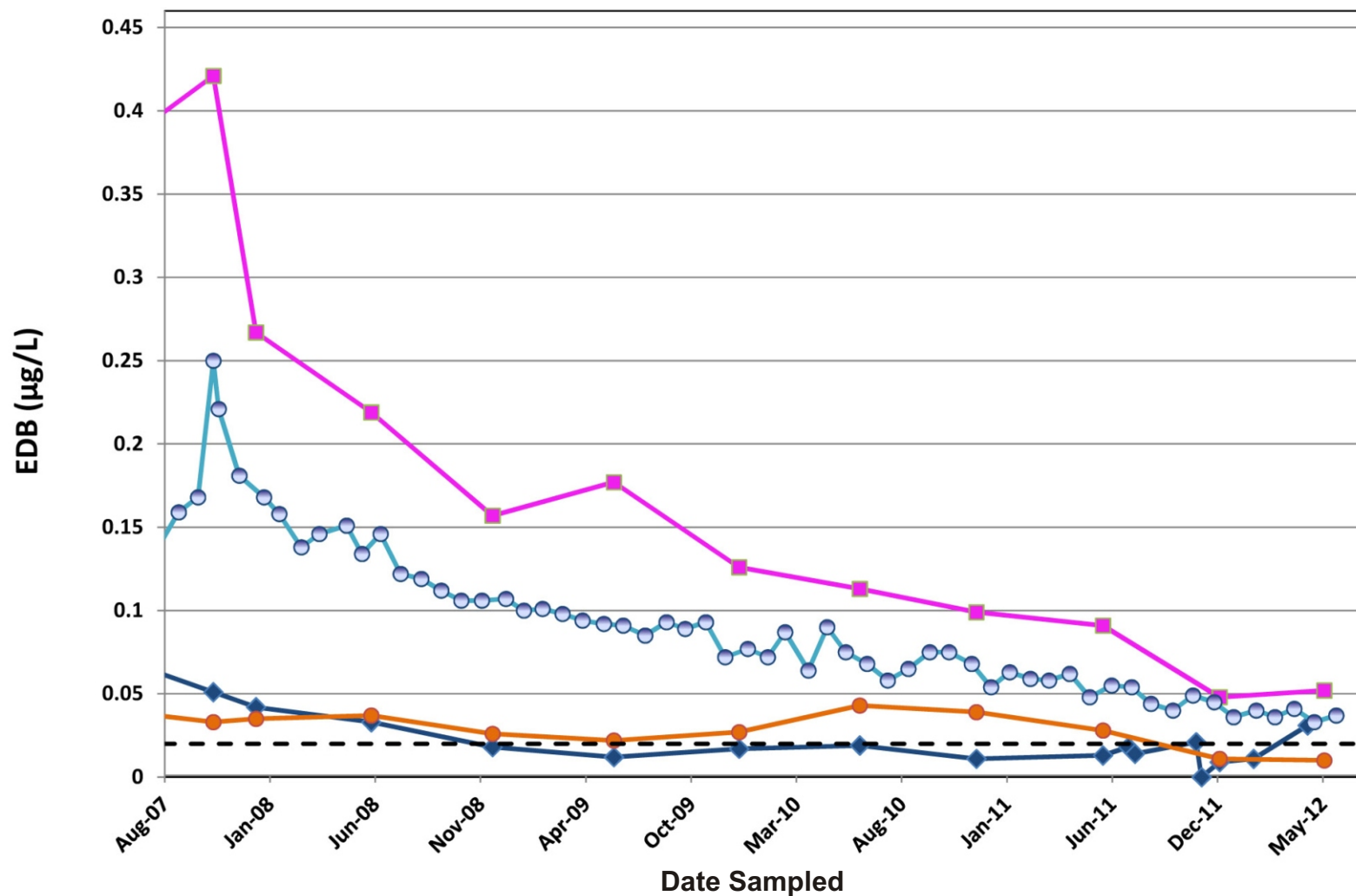
#### Legend

- ◆ 36EW0001
- 36EW0005
- 36EW0007
- 36EW0011
- Plant Influent
- MMCL

#### FIGURE 8

#### FS-1 EXTRACTION WELL AND PLANT INFLUENT DATA (2003 - PRESENT)

AFCEE - Massachusetts Military Reservation  
27 September 2012 Technical Update Meeting



Data Source: AFCEE, August 2012, MMR-AFCEE Data Warehouse

#### Legend

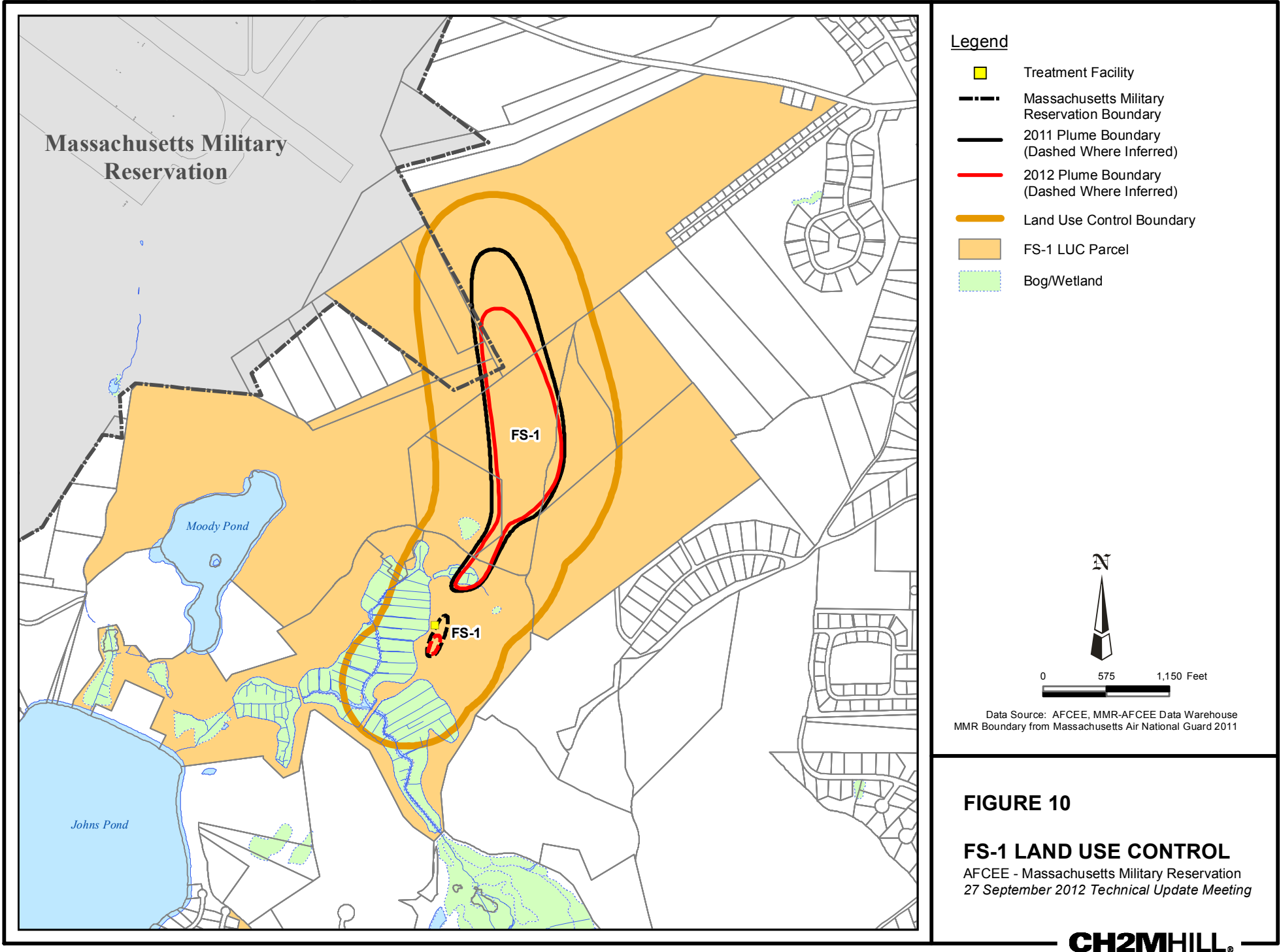
- ◆ 36EW0001\*
- 36EW0005
- ◆ 36EW0011
- Plant Influent
- MMCL

\*36EW0001 undergoing packer and influent flow testing beginning July 2011

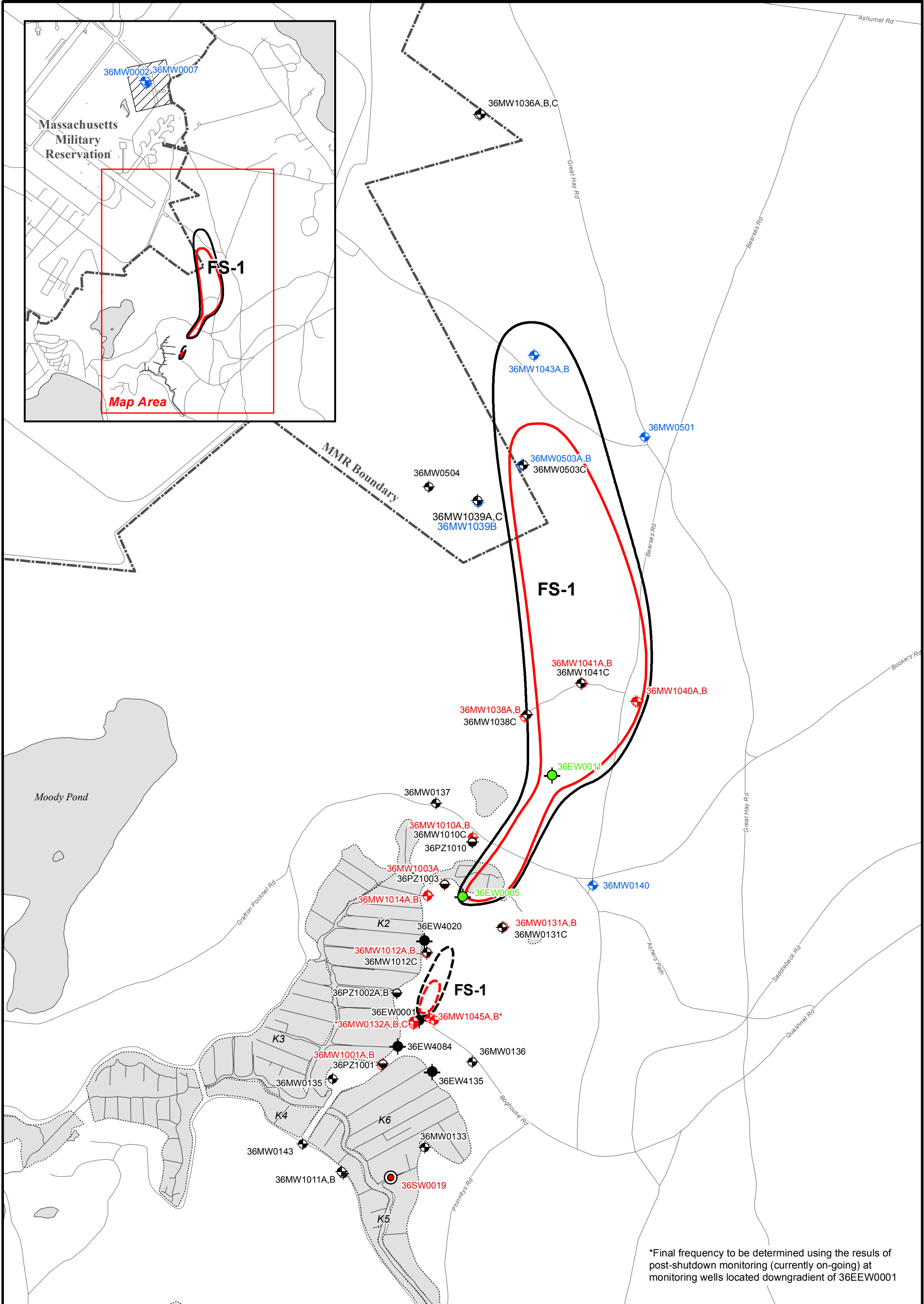
#### FIGURE 9

#### FS-1 EXTRACTION WELL AND PLANT INFLUENT DATA - 5 YEAR OVERVIEW

AFCEE - Massachusetts Military Reservation  
27 September 2012 Technical Update Meeting







\*Final frequency to be determined using the results of post-shutdown monitoring (currently on-going) at monitoring wells located downgradient of 36EEW0001

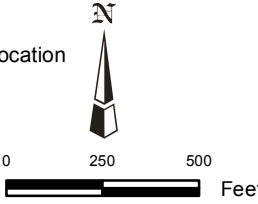
**Legend**

- 2011 Plume Boundary (Dashed Where Inferred)
- 2012 Plume Boundary (Dashed Where Inferred)
- Massachusetts Military Reservation Boundary
- FS-1 Source Area
- Bog/Wetland

**Well Type:**

- Monitoring Well
  - Extraction Well
  - Piezometer
  - Surface Water Sampling Location
- Sampling Frequency:**
- Annual
  - Biennial
  - Semiannual
  - Not Sampled

Data Source: AFCEE, August 2012, MMR-AFCEE Data Warehouse  
MMR Boundary from Massachusetts Air National Guard 2011



**FIGURE 11**  
**UPDATED FS-1 PLUME BOUNDARY AND OPTIMIZED SPEIM CHEMICAL MONITORING NETWORK**  
AFCEE - Massachusetts Military Reservation  
27 September 2012 Technical Update Meeting

**Table 1**  
**FS-1 Remedial Systems Electrical Consumption and Associated Air Emissions**  
**27 September 2012 Technical Update Meeting**

Volume of Groundwater Treated (million gallons)		6/15/2011 to 6/14/2012	System Startup (4/1999) to 6/14/2011 <sup>4</sup>
		241	2,720
Groundwater COC Mass Removal (pounds)		0.065	17.92
Electrical Usage (MWh)		276	4,652
Estimated Air Emissions <sup>1</sup> (based on electrical usage)	CO <sub>2</sub> (tons)	181	3,082
	NO <sub>x</sub> (lbs)	389	6,531
	PM-10 (lbs)	22	368
	SO <sub>2</sub> (lbs)	1,038	16,979
	VOCs (lbs)	14	231
Estimated Reduction in Air Emissions due to Green Power Purchases <sup>2</sup>	CO <sub>2</sub> (tons)	90	445
	NO <sub>x</sub> (lbs)	195	843
	PM-10 (lbs)	11	41
	SO <sub>2</sub> (lbs)	519	1,755
	VOCs (lbs)	7	33
Estimated Reduction in Air Emissions due to MMR Wind Turbine Operation <sup>3</sup>	CO <sub>2</sub> (tons)	90	154
	NO <sub>x</sub> (lbs)	195	332
	PM-10 (lbs)	11.0	19.0
	SO <sub>2</sub> (lbs)	519	885
	VOCs (lbs)	7.0	11.6
Estimated Total Air Emissions with consideration of Green Power Purchases and MMR Wind Turbine Operation	CO <sub>2</sub> (tons)	0	2,483
	NO <sub>x</sub> (lbs)	0	5,355
	PM-10 (lbs)	0	308
	SO <sub>2</sub> (lbs)	0	14,339
	VOCs (lbs)	0	187

**Notes:**

1) The estimated air emissions presented in this table are based on the assumption that until 4/30/2009, the power used to operate the MMR remedial systems was provided by the Mirant Canal Station power plant in Sandwich, MA. This power plant primarily produced electricity generated by the combustion of fuel oil and has been off-line since 5/1/2009. Starting on 5/1/2009, air emissions are based on electricity generated by the average mix of power sources in Massachusetts. Air emissions were calculated using MMR utility data from AFCEE's Metrix 4 Utility Accounting Software

(<http://www.abraxasenergy.com/metrix4.php>) and emission factors obtained from the following websites:

<http://www.csgnetwork.com/elecpowerpolcalc.html>

<http://www.metrixcentral.com/EmissionsCalculator/Emissions%20Factors%202004.pdf>

2) Emissions offset by purchases of electricity from renewable sources beginning 7/1/2008.

3) Emissions offset by operation of AFCEE-owned wind turbines beginning on 12/2/2009 (Wind I) and 11/1/2011 (Wind II).

4) System was not operational between October 2002 and September 2003, system was down due to a fire that consumed the original plant.

**Key:**

COC = contaminant of concern

CO<sub>2</sub> = carbon dioxide

FS-1 = Fuel Spill-1

lbs = pounds

MMR = Massachusetts Military Reservation

MWh = megawatt hours

NO<sub>x</sub> = nitrogen oxides

PM-10 = particulate matter with a diameter of 10 micrometers or less

SO<sub>2</sub> = sulfur dioxide

VOCs = volatile organic compounds

**Table 2**  
**FS-1 Optimized Chemical Monitoring Network - August 2012**  
**27 September 2012 Technical Update Meeting**

Location	Rationale for Location	Current Frequency	Proposed Frequency	Parameters
<b>Groundwater Monitoring Network</b>				
36EW0001	Southern most extraction well	SA	NM <sup>1</sup>	EDB
36EW0005	Western most extraction well	SA	SA	EDB
36EW0011	Northern most extraction well	SA	SA	EDB
36EW4020	Upper reach of the K2 bog east ditch	A	NM	EDB
36EW4084	Middle reach of the K2 bog east ditch	A	NM	EDB
36EW4135	Northern K6 bog ditch	A	NM	EDB
36MW0002	Source area well	BE	BE	Lead
36MW0007	Source area well	BE	BE	Lead
36MW0131A	Monitor plume downgradient of 36EW0005	A	A	EDB
36MW0131B	Monitor plume downgradient of 36EW0005	A	A	EDB
36MW0131C	Monitor plume downgradient of 36EW0005	A	NM	EDB
36MW0132A	Monitor immediately downgradient of 36EW0001	A	A <sup>1</sup>	EDB
36MW0132B	Monitor immediately downgradient of 36EW0001	A	A <sup>1</sup>	EDB
36MW0132C	Monitor immediately downgradient of 36EW0001	A	A <sup>1</sup>	EDB
36MW0133	Monitor southeastern plume boundary	BE	NM	EDB
36MW0135	Monitor southwestern plume boundary	BE	NM	EDB
36MW0136	Monitor southeastern plume boundary	BE	NM	EDB
36MW0137	Monitor western plume boundary	BE	NM	EDB
36MW0140	Monitor eastern plume boundary	TE	BE	EDB
36MW0143	Monitor southern plume boundary	TE	NM	EDB
36MW0501	Monitor eastern plume boundary	TE	BE	EDB
36MW0503A	Monitor plume upgradient of 36EW0011	BE	BE	EDB
36MW0503B	Monitor plume upgradient of 36EW0011	BE	BE	EDB
36MW0503C	Monitor plume upgradient of 36EW0011	BE	NM	EDB
36MW0504	Monitor western plume boundary	TE	NM	EDB
36MW1001A	Monitor aquifer between K2 and K6 bogs	A	A	EDB
36MW1001B	Monitor aquifer between K2 and K6 bogs	A	A	EDB
36MW1003A	Monitor western plume boundary lateral to 36EW0005	A	A	EDB
36MW1010A	Monitor western plume boundary upgradient of 36EW0005	A	A	EDB
36MW1010B	Monitor western plume boundary upgradient of 36EW0005	A	A	EDB
36MW1010C	Monitor western plume boundary upgradient of 36EW0005	A	NM	EDB
36MW1011A	Monitor southern plume boundary	TE	NM	EDB
36MW1011B	Monitor southern plume boundary	TE	NM	EDB
36MW1012A	Monitor aquifer adjacent to the K2 bog	A	A	EDB
36MW1012B	Monitor aquifer adjacent to the K2 bog	A	A	EDB
36MW1012C	Monitor aquifer adjacent to the K2 bog	A	NM	EDB
36MW1014A	Monitor western plume boundary lateral to 36EW0005	A	A	EDB
36MW1014B	Monitor western plume boundary lateral to 36EW0005	A	A	EDB
36MW1036A	Monitor trailing edge of the plume	TE	NM	EDB
36MW1036B	Monitor trailing edge of the plume	TE	NM	EDB
36MW1036C	Monitor trailing edge of the plume	TE	NM	EDB
36MW1038A	Monitor the plume upgradient of 36EW0011	A	A	EDB
36MW1038B	Monitor the plume upgradient of 36EW0011	A	A	EDB
36MW1038C	Monitor the plume upgradient of 36EW0011	A	NM	EDB
36MW1039A	Monitor the western plume boundary	BE	NM	EDB
36MW1039B	Monitor the western plume boundary	BE	BE	EDB
36MW1039C	Monitor the western plume boundary	BE	NM	EDB
36MW1040A	Monitor the western plume boundary	A	A	EDB
36MW1040B	Monitor the western plume boundary	A	A	EDB
36MW1041A	Monitor the plume upgradient of 36EW0011	A	A	EDB
36MW1041B	Monitor the plume upgradient of 36EW0011	A	A	EDB
36MW1041C	Monitor the plume upgradient of 36EW0011	A	NM	EDB
36MW1043A	Monitor aquifer upgradient of plume	TE	BE	EDB
36MW1043B	Monitor aquifer upgradient of plume	TE	BE	EDB
36MW1045A	Monitor aquifer adjacent to 36EW0001	NM	A <sup>1</sup>	EDB
36MW1045B	Monitor aquifer adjacent to 36EW0001	NM	A <sup>1</sup>	EDB
36PZ1001	Monitor aquifer between K2 and K6 bogs	A	NM	EDB
36PZ1002A	Monitor uncaptured portion of plume adjacent to the K2 bog	A	NM	EDB
36PZ1002B	Monitor aquifer adjacent to the K2 bog	A	NM	EDB
36PZ1003	Monitor aquifer lateral to 36EW0005	A	NM	EDB
36PZ1010	Monitor aquifer upgradient of 36EW0005	A	NM	EDB
<b>Surface Water Monitoring Network</b>				
36SW0019	Monitor surface water at Quashnet River	A	A	EDB

Data Source: AFCEE, August 2012, MMR-AFCEE Data Warehouse

Note:

- Final frequency to be determined using the results of post-shutdown monitoring (currently on-going) at these wells located downgradient of 36EW0001.

Key:

A = annually	NM = not monitored
BE = biennially	Q = quarterly
EDB = ethylene dibromide	SA = semiannual
FS-1 = Fuel Spill-1	TE = triennial

Table 3

**Summary of EDB Groundwater Data at FS-1 Monitoring Wells and Piezometers Proposed for Removal from SPEIM Network  
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Location	Date	EDB (µg/L) MMCL <sup>1</sup> = 0.02
36EW4020	4/8/1999	2.87
36EW4020	12/28/1999	1.83
36EW4020	4/11/2001	0.038
36EW4020	10/16/2001	0.023
36EW4020	3/21/2002	0.02
36EW4020	11/7/2002	BRL
36EW4020	11/26/2002	ND
36EW4020	12/13/2002	ND
36EW4020	3/24/2003	ND
36EW4020	5/21/2003	ND
36EW4020	7/25/2003	BRL
36EW4020	9/18/2003	0.013
36EW4020	12/16/2003	0.019
36EW4020	6/8/2004	0.026
36EW4020	8/20/2004	0.043
36EW4020	11/30/2004	0.045
36EW4020	5/11/2005	0.042
36EW4020	11/7/2005	0.021
36EW4020	4/14/2006	0.027
36EW4020	5/30/2007	ND
36EW4020	6/10/2008	ND
36EW4020	6/26/2009	ND
36EW4020	6/11/2010	ND
36EW4020	6/23/2011	ND
36EW4020	5/21/2012	ND
36EW4084	12/18/2002	0.108
36EW4084	3/24/2003	0.012
36EW4084	5/20/2003	BRL
36EW4084	7/30/2003	BRL
36EW4084	9/18/2003	BRL
36EW4084	12/16/2003	0.26
36EW4084	6/8/2004	0.049
36EW4084	8/20/2004	0.021
36EW4084	11/30/2004	BRL
36EW4084	5/11/2005	0.184
36EW4084	11/8/2005	0.028
36EW4084	4/18/2006	0.027
36EW4084	5/31/2007	0.026
36EW4084	6/10/2008	0.028
36EW4084	6/25/2009	ND
36EW4084	6/14/2010	ND
36EW4084	6/24/2011	ND
36EW4084	5/21/2012	ND
36EW4135	11/7/2002	ND
36EW4135	11/26/2002	ND
36EW4135	12/13/2002	ND
36EW4135	1/28/2003	ND
36EW4135	3/25/2003	ND
36EW4135	5/20/2003	ND
36EW4135	7/30/2003	ND
36EW4135	9/19/2003	ND
36EW4135	8/20/2004	ND
36EW4135	5/11/2005	ND
36EW4135	11/8/2005	ND

Table 3

**Summary of EDB Groundwater Data at FS-1 Monitoring Wells and Piezometers Proposed for Removal from SPEIM Network  
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Location	Date	EDB (µg/L) MMCL <sup>1</sup> = 0.02
36EW4135	4/19/2006	ND
36EW4135	5/30/2007	ND
36EW4135	6/10/2008	ND
36EW4135	6/25/2009	ND
36EW4135	6/14/2010	ND
36EW4135	6/24/2011	ND
36EW4135	5/21/2012	ND
36MW0131C	10/25/1999	ND
36MW0131C	10/4/2000	ND
36MW0131C	1/16/2002	ND
36MW0131C	3/20/2002	0.111
36MW0131C	6/11/2002	ND
36MW0131C	9/9/2002	ND
36MW0131C	11/6/2002	ND
36MW0131C	11/22/2002	ND
36MW0131C	12/12/2002	ND
36MW0131C	1/21/2003	ND
36MW0131C	3/14/2003	ND
36MW0131C	5/22/2003	ND
36MW0131C	7/31/2003	ND
36MW0131C	9/18/2003	ND
36MW0131C	12/12/2003	ND
36MW0131C	5/27/2004	ND
36MW0131C	8/19/2004	ND
36MW0131C	11/19/2004	ND
36MW0131C	5/10/2005	ND
36MW0131C	11/28/2005	ND
36MW0131C	4/21/2006	ND
36MW0131C	5/30/2007	ND
36MW0131C	6/4/2008	ND
36MW0131C	6/26/2009	ND
36MW0131C	6/8/2010	ND
36MW0131C	6/23/2011	ND
36MW0131C	5/1/2012	ND
36MW0133	3/5/1999	ND
36MW0133	4/7/1999	ND
36MW0133	5/3/1999	ND
36MW0133	6/3/1999	ND
36MW0133	7/1/1999	ND
36MW0133	7/28/1999	ND
36MW0133	8/26/1999	ND
36MW0133	10/4/1999	ND
36MW0133	10/26/1999	ND
36MW0133	11/23/1999	ND
36MW0133	1/3/2000	ND
36MW0133	3/1/2000	ND
36MW0133	3/29/2000	ND
36MW0133	4/26/2000	ND
36MW0133	5/25/2000	ND
36MW0133	6/19/2000	ND
36MW0133	7/24/2000	ND
36MW0133	8/28/2000	ND
36MW0133	9/25/2000	ND
36MW0133	10/23/2000	ND

Table 3

Summary of EDB Groundwater Data at FS-1 Monitoring Wells and Piezometers Proposed for Removal from SPEIM Network  
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Location	Date	EDB (µg/L) MMCL <sup>1</sup> = 0.02
36MW0133	11/27/2000	ND
36MW0133	12/20/2000	ND
36MW0133	4/10/2001	ND
36MW0133	10/15/2001	ND
36MW0133	1/18/2002	ND
36MW0133	3/21/2002	ND
36MW0133	6/27/2002	ND
36MW0133	9/6/2002	ND
36MW0133	11/6/2002	ND
36MW0133	11/22/2002	ND
36MW0133	12/16/2002	ND
36MW0133	1/29/2003	ND
36MW0133	3/28/2003	ND
36MW0133	5/21/2003	ND
36MW0133	7/24/2003	ND
36MW0133	9/18/2003	ND
36MW0133	1/8/2004	ND
36MW0133	6/7/2004	ND
36MW0133	8/19/2004	ND
36MW0133	11/19/2004	ND
36MW0133	5/10/2005	ND
36MW0133	4/20/2006	ND
36MW0133	6/4/2008	ND
36MW0133	6/23/2010	ND
36MW0133	5/4/2012	ND
36MW0135	10/25/1999	ND
36MW0135	10/6/2000	ND
36MW0135	4/10/2001	ND
36MW0135	10/15/2001	ND
36MW0135	1/22/2002	ND
36MW0135	3/21/2002	ND
36MW0135	6/27/2002	ND
36MW0135	9/18/2002	ND
36MW0135	11/8/2002	ND
36MW0135	11/25/2002	ND
36MW0135	12/16/2002	ND
36MW0135	1/30/2003	ND
36MW0135	3/25/2003	ND
36MW0135	5/21/2003	ND
36MW0135	7/24/2003	ND
36MW0135	10/1/2003	ND
36MW0135	1/8/2004	ND
36MW0135	6/7/2004	ND
36MW0135	8/19/2004	ND
36MW0135	11/22/2004	ND
36MW0135	5/10/2005	ND
36MW0135	11/17/2005	ND
36MW0135	4/20/2006	ND
36MW0135	6/4/2008	ND
36MW0135	6/23/2010	ND
36MW0135	5/4/2012	ND
36MW0136	10/22/1999	<b>0.06</b>
36MW0136	10/5/2000	0.016
36MW0136	4/10/2001	<b>0.055</b>

Table 3

**Summary of EDB Groundwater Data at FS-1 Monitoring Wells and Piezometers Proposed for Removal from SPEIM Network  
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<b>Location</b>	<b>Date</b>	<b>EDB (µg/L) MMCL<sup>1</sup> = 0.02</b>
36MW0136	10/15/2001	BRL
36MW0136	1/22/2002	0.01
36MW0136	3/21/2002	<b>0.033</b>
36MW0136	6/27/2002	0.015
36MW0136	9/18/2002	0.01
36MW0136	11/8/2002	0.018
36MW0136	11/27/2002	<b>0.027</b>
36MW0136	12/16/2002	<b>0.031</b>
36MW0136	1/22/2003	<b>0.056</b>
36MW0136	3/25/2003	<b>0.086</b>
36MW0136	5/22/2003	<b>0.043</b>
36MW0136	7/24/2003	0.014
36MW0136	10/1/2003	0.018
36MW0136	1/6/2004	ND
36MW0136	5/27/2004	ND
36MW0136	8/26/2004	ND
36MW0136	11/29/2004	ND
36MW0136	5/10/2005	ND
36MW0136	4/21/2006	ND
36MW0136	6/4/2008	ND
36MW0136	6/23/2010	ND
36MW0136	5/1/2012	ND
36MW0137	10/25/1999	<b>0.384</b>
36MW0137	4/27/2000	<b>0.177</b>
36MW0137	10/4/2000	<b>0.2</b>
36MW0137	4/10/2001	<b>0.121</b>
36MW0137	10/15/2001	<b>0.166</b>
36MW0137	1/17/2002	<b>0.119</b>
36MW0137	3/20/2002	<b>0.074</b>
36MW0137	6/20/2002	<b>0.054</b>
36MW0137	9/17/2002	<b>0.08</b>
36MW0137	12/10/2002	<b>0.101</b>
36MW0137	3/25/2003	<b>0.117</b>
36MW0137	6/25/2003	<b>0.202</b>
36MW0137	10/1/2003	<b>0.301</b>
36MW0137	1/6/2004	<b>0.096</b>
36MW0137	5/27/2004	BRL
36MW0137	8/26/2004	BRL
36MW0137	11/29/2004	ND
36MW0137	5/13/2005	ND
36MW0137	11/29/2005	ND
36MW0137	4/24/2006	ND
36MW0137	6/4/2008	ND
36MW0137	6/23/2010	ND
36MW0137	5/4/2012	ND
36MW0143	10/25/1999	ND
36MW0143	10/11/2000	ND
36MW0143	4/12/2001	ND
36MW0143	10/16/2001	ND
36MW0143	1/16/2002	ND
36MW0143	3/21/2002	ND
36MW0143	6/27/2002	ND
36MW0143	9/11/2002	ND
36MW0143	12/12/2002	ND

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**Summary of EDB Groundwater Data at FS-1 Monitoring Wells and Piezometers Proposed for Removal from SPEIM Network  
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Location	Date	EDB (µg/L) MMCL <sup>1</sup> = 0.02
36MW0143	3/28/2003	ND
36MW0143	6/18/2003	ND
36MW0143	10/3/2003	ND
36MW0143	1/8/2004	ND
36MW0143	6/3/2004	ND
36MW0143	12/6/2004	ND
36MW0143	5/26/2005	ND
36MW0143	5/1/2006	ND
36MW0143	6/25/2009	ND
36MW0143	5/4/2012	ND
36MW0503C	4/27/2000	<b>0.037</b>
36MW0503C	10/12/2000	<b>0.026</b>
36MW0503C	1/23/2002	<b>0.021</b>
36MW0503C	3/27/2002	<b>0.023</b>
36MW0503C	6/26/2002	0.017
36MW0503C	9/9/2002	0.014
36MW0503C	12/4/2002	0.014
36MW0503C	3/14/2003	0.013
36MW0503C	9/30/2003	BRL
36MW0503C	6/9/2004	BRL
36MW0503C	11/23/2004	BRL
36MW0503C	5/16/2005	ND
36MW0503C	4/19/2006	ND
36MW0503C	6/9/2008	BRL
36MW0503C	6/23/2010	ND
36MW0503C	5/7/2012	ND
36MW0504	5/1/2000	ND
36MW0504	10/19/2000	ND
36MW0504	1/18/2002	ND
36MW0504	3/27/2002	ND
36MW0504	6/26/2002	ND
36MW0504	9/18/2002	ND
36MW0504	12/30/2002	ND
36MW0504	4/21/2003	ND
36MW0504	10/1/2003	ND
36MW0504	6/11/2004	ND
36MW0504	12/6/2004	ND
36MW0504	5/17/2005	ND
36MW0504	4/19/2006	ND
36MW0504	6/23/2009	ND
36MW0504	5/7/2012	ND
36MW1010C	1/20/2000	ND
36MW1010C	10/12/2000	ND
36MW1010C	4/11/2001	ND
36MW1010C	10/16/2001	ND
36MW1010C	1/18/2002	ND
36MW1010C	3/25/2002	ND
36MW1010C	6/13/2002	ND
36MW1010C	9/9/2002	ND
36MW1010C	12/12/2002	ND
36MW1010C	3/18/2003	ND
36MW1010C	6/26/2003	ND
36MW1010C	9/19/2003	ND



Table 3

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Location	Date	EDB (µg/L) MMCL <sup>1</sup> = 0.02
36MW1010C	12/15/2003	ND
36MW1010C	6/11/2004	ND
36MW1010C	8/23/2004	ND
36MW1010C	11/23/2004	ND
36MW1010C	5/9/2005	ND
36MW1010C	11/2/2005	ND
36MW1010C	4/24/2006	ND
36MW1010C	5/30/2007	ND
36MW1010C	6/9/2008	ND
36MW1010C	6/25/2009	ND
36MW1010C	6/8/2010	ND
36MW1010C	6/22/2011	ND
36MW1010C	5/7/2012	ND
36MW1011A	1/20/2000	ND
36MW1011A	10/11/2000	ND
36MW1011A	4/13/2001	ND
36MW1011A	10/15/2001	ND
36MW1011A	1/18/2002	ND
36MW1011A	3/21/2002	ND
36MW1011A	6/13/2002	ND
36MW1011A	9/13/2002	ND
36MW1011A	12/5/2002	ND
36MW1011A	3/24/2003	ND
36MW1011A	6/25/2003	ND
36MW1011A	9/17/2003	ND
36MW1011A	1/20/2004	ND
36MW1011A	6/7/2004	ND
36MW1011A	8/26/2004	ND
36MW1011A	11/29/2004	ND
36MW1011A	5/26/2005	ND
36MW1011A	4/24/2006	ND
36MW1011A	6/23/2009	ND
36MW1011A	5/4/2012	ND
36MW1011B	1/27/2000	ND
36MW1011B	1/18/2002	ND
36MW1011B	3/21/2002	ND
36MW1011B	6/13/2002	ND
36MW1011B	9/13/2002	ND
36MW1011B	12/5/2002	ND
36MW1011B	3/24/2003	ND
36MW1011B	6/25/2003	ND
36MW1011B	9/17/2003	ND
36MW1011B	12/15/2003	ND
36MW1011B	6/7/2004	ND
36MW1011B	8/26/2004	ND
36MW1011B	11/29/2004	ND
36MW1011B	5/26/2005	ND
36MW1011B	4/24/2006	ND
36MW1011B	6/23/2009	ND
36MW1011B	5/4/2012	ND
36MW1012C	1/20/2000	<b>0.077</b>
36MW1012C	10/6/2000	ND
36MW1012C	4/11/2001	ND

Table 3

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Location	Date	EDB (µg/L) MMCL <sup>1</sup> = 0.02
36MW1012C	10/16/2001	ND
36MW1012C	1/17/2002	ND
36MW1012C	3/25/2002	ND
36MW1012C	6/12/2002	ND
36MW1012C	9/12/2002	ND
36MW1012C	12/12/2002	ND
36MW1012C	3/14/2003	ND
36MW1012C	6/30/2003	ND
36MW1012C	9/23/2003	ND
36MW1012C	12/12/2003	ND
36MW1012C	6/1/2004	ND
36MW1012C	8/24/2004	ND
36MW1012C	11/24/2004	ND
36MW1012C	5/26/2005	ND
36MW1012C	11/9/2005	ND
36MW1012C	4/24/2006	ND
36MW1012C	5/30/2007	ND
36MW1012C	6/4/2008	ND
36MW1012C	6/25/2009	ND
36MW1012C	6/8/2010	ND
36MW1012C	6/23/2011	ND
36MW1012C	5/21/2012	ND
36MW1036A	10/9/2000	0.015
36MW1036A	1/17/2002	0.013
36MW1036A	3/25/2002	0.013
36MW1036A	6/12/2002	0.012
36MW1036A	9/18/2002	BRL
36MW1036A	12/3/2002	BRL
36MW1036A	3/20/2003	BRL
36MW1036A	9/25/2003	BRL
36MW1036A	6/14/2004	BRL
36MW1036A	11/24/2004	BRL
36MW1036A	5/13/2005	BRL
36MW1036A	6/23/2009	ND
36MW1036A	5/21/2012	ND
36MW1036B	10/9/2000	<b>0.081</b>
36MW1036B	8/2/2001	<b>0.209</b>
36MW1036B	1/17/2002	<b>0.26</b>
36MW1036B	3/25/2002	<b>0.268</b>
36MW1036B	6/12/2002	<b>0.183</b>
36MW1036B	9/18/2002	<b>0.059</b>
36MW1036B	12/3/2002	<b>0.039</b>
36MW1036B	3/20/2003	<b>0.045</b>
36MW1036B	9/25/2003	0.019
36MW1036B	6/14/2004	0.012
36MW1036B	11/24/2004	0.019
36MW1036B	5/13/2005	ND
36MW1036B	6/23/2009	ND
36MW1036B	5/21/2012	ND
36MW1036C	10/9/2000	<b>0.056</b>
36MW1036C	8/2/2001	<b>0.062</b>
36MW1036C	1/17/2002	<b>0.057</b>
36MW1036C	3/25/2002	<b>0.043</b>

Table 3

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<b>Location</b>	<b>Date</b>	<b>EDB (µg/L) MMCL<sup>1</sup> = 0.02</b>
36MW1036C	6/12/2002	<b>0.035</b>
36MW1036C	9/18/2002	<b>0.023</b>
36MW1036C	12/3/2002	<b>0.026</b>
36MW1036C	3/20/2003	<b>0.031</b>
36MW1036C	9/25/2003	<b>0.028</b>
36MW1036C	6/14/2004	<b>0.02</b>
36MW1036C	11/24/2004	<b>0.026</b>
36MW1036C	5/13/2005	0.018
36MW1036C	6/23/2009	0.011
36MW1036C	5/21/2012	ND
36MW1038C	10/17/2000	<b>0.021</b>
36MW1038C	1/21/2002	0.018
36MW1038C	3/27/2002	0.016
36MW1038C	6/12/2002	<b>0.02</b>
36MW1038C	9/19/2002	0.012
36MW1038C	12/4/2002	0.016
36MW1038C	3/14/2003	0.01
36MW1038C	9/23/2003	ND
36MW1038C	6/10/2004	0.014
36MW1038C	8/25/2004	0.012
36MW1038C	12/6/2004	0.01
36MW1038C	5/19/2005	0.012
36MW1038C	11/29/2005	ND
36MW1038C	4/18/2006	ND
36MW1038C	5/30/2007	ND
36MW1038C	6/9/2008	ND
36MW1038C	6/23/2009	ND
36MW1038C	6/11/2010	ND
36MW1038C	6/22/2011	ND
36MW1038C	5/3/2012	ND
36MW1039A	10/17/2000	ND
36MW1039A	6/28/2002	ND
36MW1039A	9/20/2002	ND
36MW1039A	12/3/2002	ND
36MW1039A	3/20/2003	ND
36MW1039A	9/29/2003	ND
36MW1039A	6/14/2004	ND
36MW1039A	12/7/2004	ND
36MW1039A	5/17/2005	ND
36MW1039A	4/24/2006	ND
36MW1039A	6/9/2008	ND
36MW1039A	6/23/2010	ND
36MW1039A	5/7/2012	ND
36MW1039C	10/19/2000	<b>0.26</b>
36MW1039C	8/8/2001	<b>0.345</b>
36MW1039C	6/28/2002	<b>0.3</b>
36MW1039C	9/20/2002	<b>0.203</b>
36MW1039C	12/3/2002	<b>0.216</b>
36MW1039C	3/20/2003	<b>0.183</b>
36MW1039C	9/29/2003	<b>0.123</b>
36MW1039C	6/14/2004	<b>0.075</b>
36MW1039C	12/7/2004	<b>0.051</b>
36MW1039C	5/17/2005	<b>0.044</b>

Table 3

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Location	Date	EDB (µg/L) MMCL <sup>1</sup> = 0.02
36MW1039C	4/24/2006	0.024
36MW1039C	6/9/2008	ND
36MW1039C	5/7/2012	ND
36MW1041C	10/18/2000	1.4
36MW1041C	1/21/2002	0.849
36MW1041C	3/21/2002	1.25
36MW1041C	6/14/2002	1.08
36MW1041C	9/16/2002	0.815
36MW1041C	12/3/2002	1.01
36MW1041C	3/14/2003	1.06
36MW1041C	9/23/2003	0.649
36MW1041C	6/14/2004	0.298
36MW1041C	8/25/2004	0.207
36MW1041C	12/6/2004	0.127
36MW1041C	5/20/2005	0.034
36MW1041C	11/21/2005	0.013
36MW1041C	5/1/2006	BRL
36MW1041C	5/30/2007	BRL
36MW1041C	6/9/2008	BRL
36MW1041C	6/23/2009	ND
36MW1041C	6/8/2010	ND
36MW1041C	6/22/2011	ND
36MW1041C	5/3/2012	ND
36PZ1001	1/18/2002	ND
36PZ1001	3/21/2002	ND
36PZ1001	6/18/2002	ND
36PZ1001	9/17/2002	ND
36PZ1001	11/8/2002	ND
36PZ1001	11/25/2002	ND
36PZ1001	12/16/2002	ND
36PZ1001	4/21/2003	ND
36PZ1001	5/21/2003	ND
36PZ1001	7/29/2003	ND
36PZ1001	9/24/2003	ND
36PZ1001	12/17/2003	ND
36PZ1001	6/11/2004	ND
36PZ1001	8/24/2004	ND
36PZ1001	12/1/2004	ND
36PZ1001	5/11/2005	ND
36PZ1001	11/15/2005	ND
36PZ1001	4/21/2006	ND
36PZ1001	5/31/2007	ND
36PZ1001	6/11/2008	ND
36PZ1001	6/23/2009	ND
36PZ1001	6/8/2010	ND
36PZ1001	6/24/2011	ND
36PZ1001	5/22/2012	ND
36PZ1002A	12/28/1998	ND
36PZ1002A	10/25/1999	ND
36PZ1002A	1/25/2002	ND
36PZ1002A	3/25/2002	ND
36PZ1002A	6/18/2002	ND
36PZ1002A	9/11/2002	ND

Table 3

Summary of EDB Groundwater Data at FS-1 Monitoring Wells and Piezometers Proposed for Removal from SPEIM Network  
27 September 2012 Technical Update Meeting

Location	Date	EDB (µg/L) MMCL <sup>1</sup> = 0.02
36PZ1002A	11/12/2002	ND
36PZ1002A	11/27/2002	ND
36PZ1002A	12/16/2002	ND
36PZ1002A	4/21/2003	ND
36PZ1002A	5/21/2003	ND
36PZ1002A	7/29/2003	ND
36PZ1002A	9/24/2003	ND
36PZ1002A	12/16/2003	ND
36PZ1002A	6/1/2004	ND
36PZ1002A	8/25/2004	ND
36PZ1002A	11/23/2004	ND
36PZ1002A	5/16/2005	ND
36PZ1002A	11/15/2005	ND
36PZ1002A	4/18/2006	ND
36PZ1002A	5/29/2007	ND
36PZ1002A	6/10/2008	ND
36PZ1002A	6/25/2009	ND
36PZ1002A	6/14/2010	ND
36PZ1002A	6/24/2011	ND
36PZ1002A	5/22/2012	ND
36PZ1002B	12/28/1998	ND
36PZ1002B	10/25/1999	ND
36PZ1002B	1/25/2002	ND
36PZ1002B	3/25/2002	ND
36PZ1002B	6/18/2002	ND
36PZ1002B	9/11/2002	ND
36PZ1002B	11/12/2002	ND
36PZ1002B	11/27/2002	ND
36PZ1002B	12/16/2002	ND
36PZ1002B	4/21/2003	ND
36PZ1002B	5/21/2003	ND
36PZ1002B	7/29/2003	ND
36PZ1002B	9/24/2003	ND
36PZ1002B	12/16/2003	ND
36PZ1002B	6/1/2004	ND
36PZ1002B	8/25/2004	ND
36PZ1002B	11/23/2004	ND
36PZ1002B	5/16/2005	ND
36PZ1002B	11/15/2005	ND
36PZ1002B	4/18/2006	ND
36PZ1002B	5/29/2007	ND
36PZ1002B	6/10/2008	ND
36PZ1002B	6/25/2009	ND
36PZ1002B	6/14/2010	ND
36PZ1002B	6/24/2011	ND
36PZ1002B	5/22/2012	ND
36PZ1003	1/25/2002	ND
36PZ1003	3/25/2002	ND
36PZ1003	6/21/2002	ND
36PZ1003	9/13/2002	ND
36PZ1003	11/12/2002	ND
36PZ1003	11/27/2002	ND
36PZ1003	12/18/2002	ND
36PZ1003	1/27/2003	0.116

Table 3

**Summary of EDB Groundwater Data at FS-1 Monitoring Wells and Piezometers Proposed for Removal from SPEIM Network  
27 September 2012 Technical Update Meeting**

Location	Date	EDB (µg/L) MMCL <sup>1</sup> = 0.02
36PZ1003	3/26/2003	ND
36PZ1003	5/29/2003	ND
36PZ1003	7/30/2003	ND
36PZ1003	10/1/2003	ND
36PZ1003	12/17/2003	<b>0.092</b>
36PZ1003	6/1/2004	BRL
36PZ1003	8/25/2004	ND
36PZ1003	12/1/2004	ND
36PZ1003	5/11/2005	ND
36PZ1003	11/21/2005	ND
36PZ1003	4/21/2006	ND
36PZ1003	5/31/2007	ND
36PZ1003	6/11/2008	ND
36PZ1003	6/26/2009	ND
36PZ1003	6/8/2010	ND
36PZ1003	6/24/2011	ND
36PZ1003	5/22/2012	ND
36PZ1010	1/24/2002	ND
36PZ1010	3/29/2002	ND
36PZ1010	6/13/2002	ND
36PZ1010	9/17/2002	ND
36PZ1010	12/12/2002	ND
36PZ1010	3/26/2003	ND
36PZ1010	6/26/2003	ND
36PZ1010	9/19/2003	ND
36PZ1010	1/7/2004	ND
36PZ1010	6/11/2004	ND
36PZ1010	8/23/2004	ND
36PZ1010	11/23/2004	ND
36PZ1010	5/9/2005	ND
36PZ1010	11/2/2005	ND
36PZ1010	4/17/2006	ND
36PZ1010	5/31/2007	ND
36PZ1010	6/11/2008	ND
36PZ1010	6/25/2009	ND
36PZ1010	6/14/2010	ND
36PZ1010	6/28/2011	ND
36PZ1010	5/7/2012	ND

Data Source: AFCEE, August 2012, MMR-AFCEE Data Warehouse

Notes:

1. MMCL from Massachusetts Department of Environmental Protection (MassDEP) web page, <http://www.mass.gov/dep/water/dwstand.pdf>.

**Bold** values represent EDB concentrations above the MMCL.

Key:

BRL = below the reporting limit

EDB = ethylene dibromide

FS-1 = Fuel Spill-1

MMCL = Massachusetts Maximum Contaminant Level

ND = not detected

µg/L = micrograms per liter

## **ATTACHMENT B**

### **FS-1 Monitoring Downgradient of 36EW0001, 28 November 2012 Technical Update Meeting**

# **FS-1 Monitoring Downgradient of 36EW0001**

## **28 November 2012 Technical Update Meeting**

### **Path Forward** (from 31 July 2012 ETD Optimization Project Note)

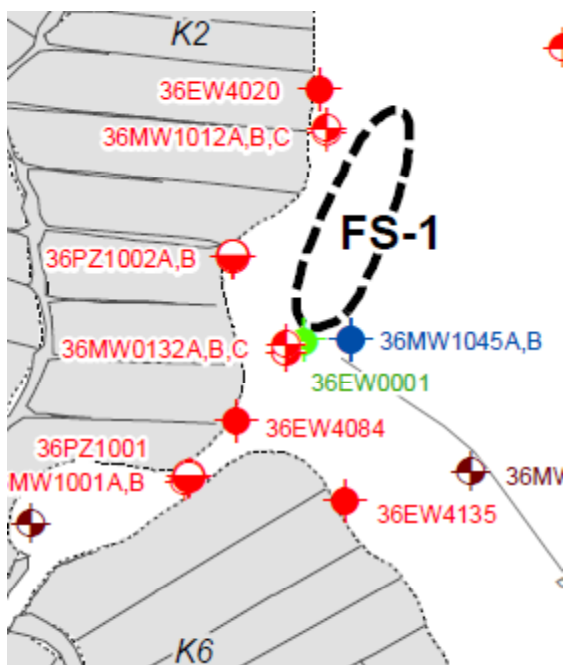
- Operate FS-1 ETD system using interim pumping configuration, 2012 Scenario 01.
  - 90EW0001 – 0 gpm
  - 90EW0005 – 175 gpm
  - 90EW0011 – 250 gpm
  
- Sample four monitoring wells (36MW0132A,B and 36MW1045A,B) that are located approximately 50 feet from 36EW0001 in July and October 2012.
  - The need to restart 36EW0001 and/or the frequency of continued monitoring at the four downgradient monitoring wells will be made in consultation with the regulatory agencies based on a review of the data collected through October 2012.



# FS-1 Monitoring Downgradient of 36EW0001

## Groundwater Monitoring Downgradient of 36EW0001

- 36EW0001 off-line on 5/8/2012.
- First post-shutdown sampling event completed 6/29/2012 – 7/2/2012.
- Second post-shutdown sampling event completed on 10/3/2012.



Location	Analyte	Date	Result	DL	RL
			all units = µg/L		
36MW0132A	EDB	5/1/2012	ND	0.005	0.01
36MW0132A	EDB	6/29/2012	ND	0.005	0.011
36MW0132A	EDB	10/3/2012	ND	0.005	0.011
36MW0132B	EDB	5/1/2012	ND	0.005	0.01
36MW0132B	EDB	6/29/2012	ND	0.005	0.01
36MW0132B	EDB	10/3/2012	ND	0.005	0.01
36MW1045A	EDB	5/14/2012	ND	0.005	0.01
36MW1045A	EDB	7/2/2012	0.005	0.005	0.01
36MW1045A	EDB	10/3/2012	ND	0.005	0.01
36MW1045B	EDB	5/14/2012	ND	0.005	0.01
36MW1045B	EDB	7/2/2012	ND	0.005	0.01
36MW1045B	EDB	10/3/2012	ND	0.005	0.01

- Shading signifies shutdown date for 36EW0001 (05/08/2012)


# **FS-1 Monitoring Downgradient of 36EW0001**


## **Conclusions**

- With the exception of a BRL detection of EDB at 36MW1045A in July 2012, no EDB has been detected at monitoring wells located downgradient or cross gradient of 36EW0001 during two quarterly rounds of post-shutdown monitoring.
- These monitoring wells are located approximately 50 feet from 36EW0001. EDB, if present, is expected to have migrated this distance by now.


## **Recommendation**

- Leave 36EW0001 off with continued monitoring at the four nearby monitoring wells. The next sampling event at 36MW0132A,B and 35MW1045A,B will be during the annual SPEIM event (May 2013).


  <b>AFCEE</b> <b>SPEIM/LTM/O&amp;M</b> <b>Otis ANG Base, Massachusetts</b> <b>4P08-FA8903-08-D-8769-0300</b>	<b>PROJECT NOTE</b>		TASK ORDER 0300
			PROJECT NO. 420005
	DOCUMENT CONTROL NUMBER: <b>420005-SPEIM-FS1-PRJNOT-002</b>  CDRL A001k	PAGE 1 OF 4	

Confirmation Of: <input type="checkbox"/> Meeting <input type="checkbox"/> Change Notice <input checked="" type="checkbox"/> General Project Note	Date Held: Not Applicable Location: Not Applicable Date Issued: 31 July 2012 Recorded By: Mark Hilyard
Subject: <b>2012 FS-1 EXTRACTION, TREATMENT, AND DISCHARGE          SYSTEM OPTIMIZATION PROJECT NOTE</b>  <b>EPA OU-06</b>	Issued By: Nigel Tindall   <hr/> CH2M HILL TECHNICAL SERVICES GROUP MANAGER


ITEM	REMARKS
<b>1.0</b>	<b>INTRODUCTION</b>
	<p>This project note presents the results of an optimization evaluation of the Fuel Spill-1 (FS-1) extraction, treatment, and discharge (ETD) remedial system. The objective of this evaluation was to optimize the operation of FS-1 extraction well 36EW0001, which has exhibited reduced mass removal efficiency with time. The FS-1 plume is defined as the extent of groundwater contaminated with ethylene dibromide (EDB) at concentrations exceeding the Massachusetts Maximum Contaminant Level (MMCL) of 0.02 micrograms per liter (µg/L). This optimization is based on a review of FS-1 groundwater and treatment plant monitoring data collected through the Air Force Center for Engineering and the Environment (AFCEE) System Performance and Ecological Monitoring (SPEIM) program, groundwater vertical profiling data collected during a field data gap investigation, and influent flow testing results collected at extraction well 36EW0001.</p>
<b>2.0</b>	<b>BACKGROUND</b>
	<p>FS-1 extraction well 36EW0001 began operation with the startup of the final FS-1 ETD system in September 2003 (<a href="#">Figure 1</a>). The goal for this extraction well was to intercept the FS-1 plume deep in the aquifer before it upwells to surface waters of the Quashnet River bogs and remediate the portion of the aquifer that was located between 36EW0001 and the upgradient extraction well 36EW0005, which is located approximately 600 feet to the north.</p> <p>SPEIM data collected at FS-1 since 2003 indicates that the concentrations of EDB and the extent of the FS-1 plume footprint in the vicinity of 36EW0001 have decreased significantly since system startup. Specifically:</p> <ul style="list-style-type: none"> <li>• EDB is not detected at most monitoring wells located within the hydraulic capture zone of 36EW0001 (i.e., south of Grafton Pocknet Road, <a href="#">Figure 2</a>);</li> <li>• When EDB is detected, the reported concentrations are less than the MMCL and are at the deepest screens associated with each monitoring well cluster (<a href="#">Figure 3</a>);</li> </ul>

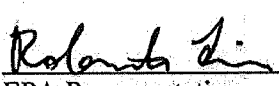

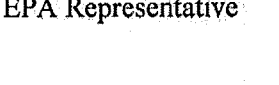
  <b>AFCEE</b> <b>SPEIM/LTM/O&amp;M</b> <b>Otis ANG Base, Massachusetts</b> <b>4P08-FA8903-08-D-8769-0300</b>	<b>PROJECT NOTE</b>		TASK ORDER 0300
			PROJECT NO. 420005
	DOCUMENT CONTROL NUMBER: <b>420005-SPEIM-FS1-PRJNOT-002</b> CDRL A001k		PAGE 2 OF 4

ITEM	REMARKS
	<ul style="list-style-type: none"> <li>EDB influent concentrations at 36EW0001 have been below the MMCL since 2008 (<a href="#">Figure 4</a>); and</li> <li>Very little mass of EDB was removed by this well in 2011 (<a href="#">Table 1</a>).</li> </ul> <p>EDB was still being detected at influent for 36EW0001 in 2010, however, no groundwater monitoring wells were located in the area of the aquifer where the FS-1 plume potentially remained. Therefore, a field data gap investigation was initiated to better characterize the distribution of EDB in the aquifer near 36EW0001.</p>
<b>3.0</b>	<b>OPTIMIZATION EVALUATION SAMPLING</b>  <u>2010 Field Data Gap Investigation</u>  Groundwater vertical profiling for EDB was completed from the water table to bedrock at two locations (36DP0101/36MW1045A,B and 36DP0102/36BH1046), using a combination of direct push and roto sonic drilling technologies ( <a href="#">Figure 5</a> ). Installation of a boring immediately upgradient of 36EW0001 is not possible due to the extremely steep topography in this area. The results of the groundwater vertical profiling ( <a href="#">Figure 6</a> ) indicate that EDB concentrations less than the MMCL are located within the immediate vicinity of 36EW0001, deep in the aquifer (>150 feet below ground surface [ft bgs]).  <u>2011 Optimization Testing at 36EW0001</u>  Extraction well 36EW0001 extracted water across a 100-foot long screen, yet groundwater monitoring data and vertical profiling results indicated that EDB remained only in the deeper portion of the aquifer near this extraction well. Therefore, there was a potential that 36EW0001 was capturing a large volume of clean water from shallower portions of the aquifer, which was possibly diluting the EDB concentrations in the influent. Therefore, in July 2011 the effective screen length of 36EW0001 was shortened with packers so that this well pumped only from the bottom 25 feet of screen, in an effort to focus extraction stresses to the deeper portion of the aquifer. A summary of EDB influent results at 36EW0001 is provided in <a href="#">Table 2</a> .  Influent sampling results collected after the shortening of the extraction well screen indicate that reducing the screen length alone did not result in an increase of EDB concentrations with the well operating at the design rate of 90 gallons per minute (gpm) ( <a href="#">Table 2</a> ). Therefore, 36EW0001 was shut down for a one week rest period. Sampling of this extraction well after a one week rest period (after a minimum purge was achieved) resulted in an EDB influent concentration of 0.021 µg/L, which was slightly above the MMCL. These flow testing results indicated that a relatively small area of EDB plume may be present in the immediate vicinity of the well screen. Therefore, the pumping rate for 36EW0001 was reduced from 90 gpm to an interim flow rate of 45 gpm in an effort to reduce the width of the hydraulic capture zone, and flow test influent sampling continued.

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		PROJECT NO. 420005
	DOCUMENT CONTROL NUMBER: <b>420005-SPEIM-FS1-PRJNOT-002</b> <b>CDRL A001k</b>	PAGE 3 OF 4

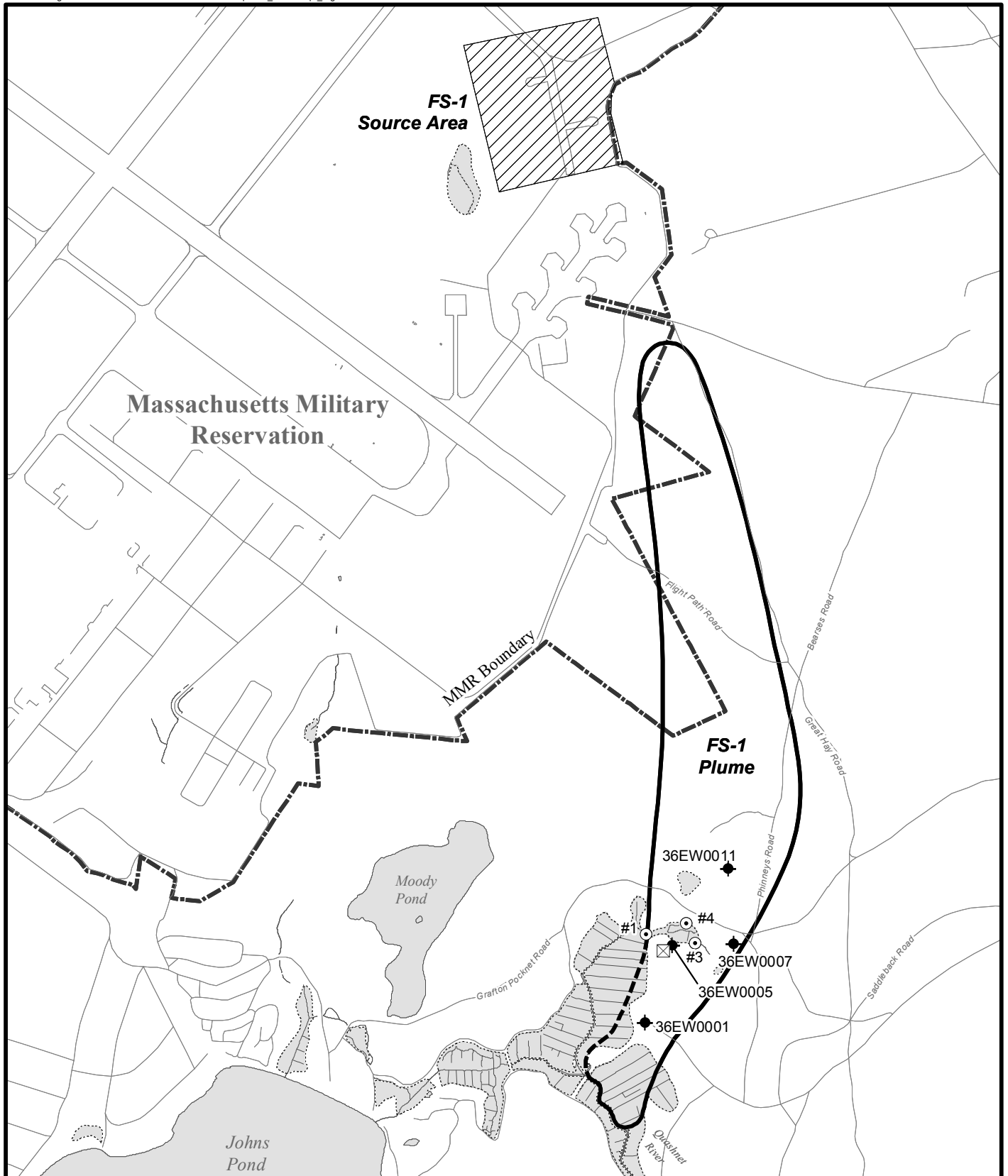
ITEM	REMARKS
	<p>Influent sampling with 36EW0001 pumping at 45 gpm continued to result in influent concentrations less than the MMCL (<a href="#">Table 2</a>). Therefore, 36EW0001 was again turned off for one week and a minimum purge sample was collected after the restart of this well. An influent concentration of 0.031 µg/L was reported.</p>
<b>4.0</b>	<p><b>CONCLUSIONS</b></p> <p>A review of the SPEIM monitoring, data gap investigation, and influent flow testing results at 36EW0001 indicated that a small area of low concentration EDB remains deep in the aquifer (&gt;150 ft bgs) in the immediate vicinity of the extraction well. Therefore continued operation of 36EW0001 using the optimized pumping configuration of a reduced screen length and lower pumping rate (<a href="#">Table 3</a>) was proposed during the 26 April 2012 Technical Update Meeting (<a href="#">Attachment A</a>). Operation of 36EW0001 was expected to continue until influent sampling results (using a minimum purge after one week rest period) were below the MMCL. On 08 May 2012, extraction well 36EW0001 shut down due to a failure of the variable frequency drive (VFD). Operation of 36EW0001 at a lower flow rate without a VFD is not possible as the flow from the current pump cannot be manually reduced without resulting in an unacceptable back-pressure on the ETD system piping and/or burning out the motor. AFCEE e-mailed the regulatory agencies on 23 May 2012 with three proposed options for a path forward regarding the non-operational VFD at 36EW0001:</p> <ol style="list-style-type: none"> <li>(1) Replace or repair the VFD at an estimated cost of \$5,000-\$15,000</li> <li>(2) Remove the VFD and replace the pump/motor in the extraction well with a smaller assembly (7.5 hp) that will reduce the backpressure and allow continued operation of the well at 45 gpm. Because remote control of the pump (and associated emergency shut-offs) is not possible without a VFD, this extraction well would operate only during working hours.</li> <li>(3) Keep the extraction well off for an interim basis with an increased sampling frequency at monitoring wells 36MW0132A, B and 36MW1045A, B, which are located approximately 35 feet downgradient and 70 feet crossgradient of 36EW0001, respectively.</li> </ol> <p>The available flow testing results for 36EW0001, groundwater monitoring data, and results of the leading edge data-gap investigation were reviewed with the regulatory agencies during the 21 June 2012 Technical Update Meeting, and during a follow-up meeting on 28 June 2012. Based on a review of the data, which indicated that a very small area of low concentration EDB remains deep in the aquifer in the immediate vicinity of this extraction well, it was agreed that 36EW0001 could remain off on an interim basis with increased monitoring at four groundwater monitoring wells located immediately downgradient and crossgradient of 36EW0001 (36MW0132A,B and 36MW1045A,B; see <a href="#">Figure 7</a>). These monitoring wells were sampled on 02 July 2012 (results are pending) and will be sampled again in October 2012. The data will be shared with the regulatory agencies at a future Technical Update Meeting. If EDB</p>

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ITEM	REMARKS
	concentrations at monitoring wells 36MW0132A,B and 36MW1045A,B increase to above the MMCL for two consecutive rounds, 36EW0001 will be returned to service. If EDB concentrations at the four downgradient monitoring wells are less than the MMCL during the July and October quarterly events, 36EW0001 will remain off and the frequency of sampling at the four downgradient monitoring wells will be re-assessed at future Technical Update Meetings.
5.0	<b>RECOMMENDATIONS</b>  Continue to operate the FS-1 ETD system using the interim pumping configuration (2012 Scenario 01) as summarized in Table 3. Additionally, the following four groundwater monitoring wells, 36MW0132A,B and 36MW1045A,B will be sampled in July and again in October 2012. A decision about restarting 36EW0001 and/or the frequency of continued monitoring at the four downgradient monitoring wells will be made, in consultation with the regulatory agencies, based on a review of the data collected through October 2012.
6.0	<b>REGULATOR COMMENTS AND CONCURRENCE</b>  Concurrence with the implementation of the interim pumping configuration "2012 Scenario 01" at the FS-1 ETD system is represented by the signatures below:  <div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="text-align: center;">             EPA Representative         </div> <div style="text-align: center;">             MassDEP Representative         </div> <div style="text-align: center;">             AFCEE Project Manager         </div> </div> <p>Note: The parties involved will retain the ability to modify the recommended path forward for 36EW0001 based on field observations or other mutually agreeable technical justifications.</p>

Attachments:

Figure 1. FS-1 Groundwater Plume and ETD System at System Startup (2003)  
 Figure 2. FS-1 2011 Ethylene Dibromide Detections in Groundwater  
 Figure 3. EDB Concentration Trends in Groundwater and Surface Water  
 Figure 4. FS-1 Extraction Well and Plant Influent Data – 5 Year Overview  
 Figure 5. FS-1 EDB Plume and Location of Cross-Section Lines  
 Figure 6. FS-1 Cross-Section B-B'  
 Figure 7. FS-1 36EW0001 Area  
 Table 1. FS-1 Treatment System Mass Removal Summary – 2011  
 Table 2. EDB Influent Concentrations at 36EW0001 Since 2008  
 Table 3. FS-1 ETD System Pumping Schedule: Current Design (2007 Scenario 01) and Optimized Design (2012 Scenario 01)  
 Attachment A: FS-1 ETD System Optimization, 26 April 2012 Technical Update Meeting



### Legend

- |     |  |   |   |
|-----|--|---|---|
| ⊙   | Outflow Bubbler                                | — | Plume Boundary<br>(Dashed Where Inferred) |
| ◆   | Extraction Well                                | ⋯ | Bog/Wetland                               |
| ⊠   | Treatment Plant                                | ▨ | Source Area                               |
| --- | Massachusetts Military<br>Reservation Boundary |   |   |

Data Source: AFCEE, January 2005, MMR-AFCEE Data Warehouse  
MMR Boundary from Massachusetts Air National Guard 2011



0 600 1,200  
Feet

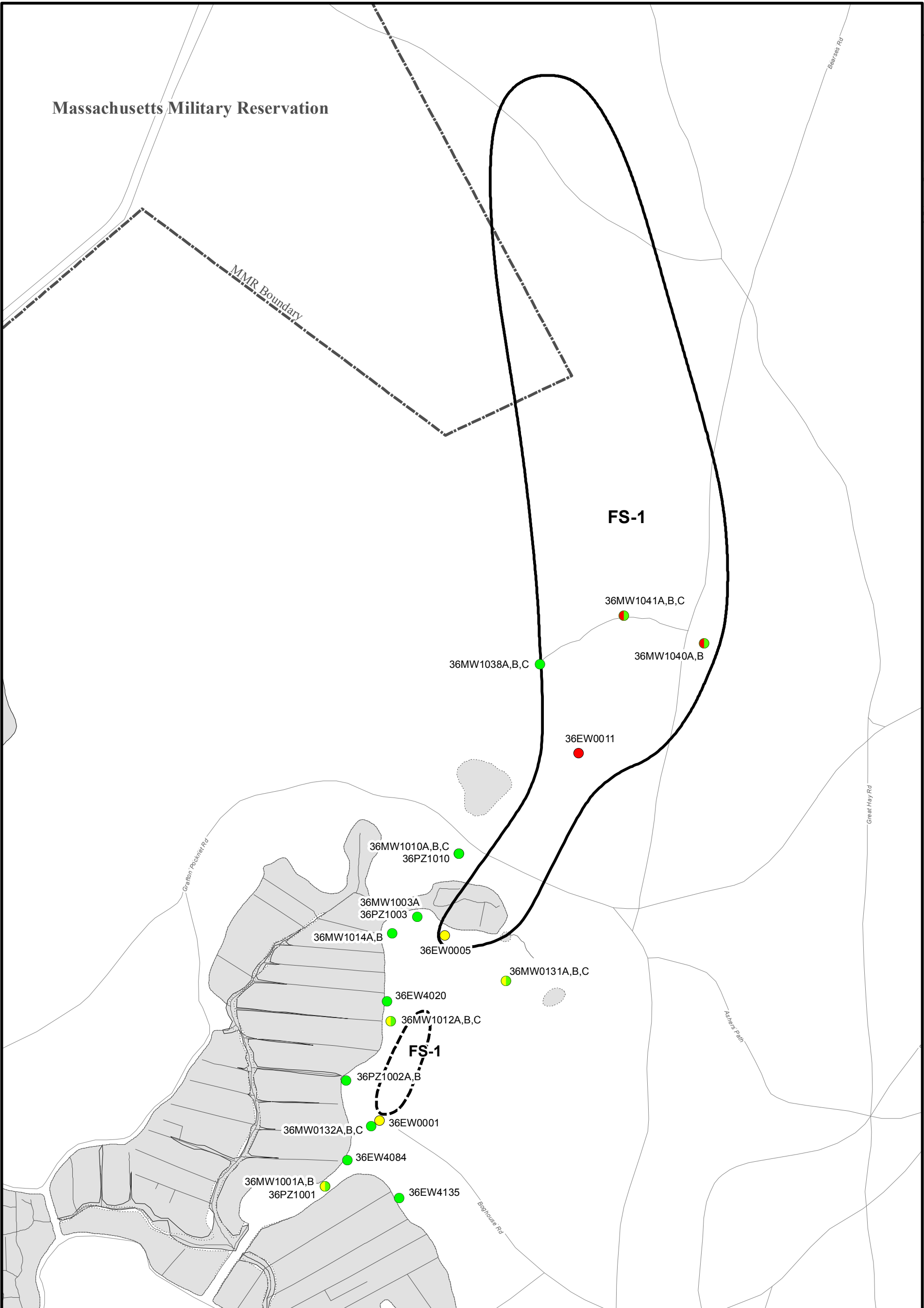
### FIGURE 1

#### FS-1 GROUNDWATER PLUME AND ETD SYSTEM AT SYSTEM STARTUP (2003)

AFCEE - Massachusetts Military Reservation  
2012 FS-1 Extraction, Treatment, and Discharge  
System Optimization Project Note

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Path: Y:\Figures\SP\EMFS12012\NET\GIS\Acmap\FS1\_12\ET\DOT\_Fig2.mxd Date: 5/1/2012 Time: 3:53:04 PM User: 126850782E

Legend

- Plume Boundary (Dashed Where Inferred)
- Massachusetts Military Reservation Boundary
- Bog/Wetland

Contaminant Detections:

- No Detection
- Detection Below or at MMCL
- Detection Above MMCL

Data Source: AFCEE, May 2012, MMR-AFCEE Data Warehouse  
MMR Boundary from Massachusetts Air National Guard 2011

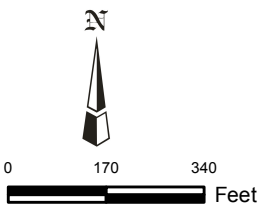


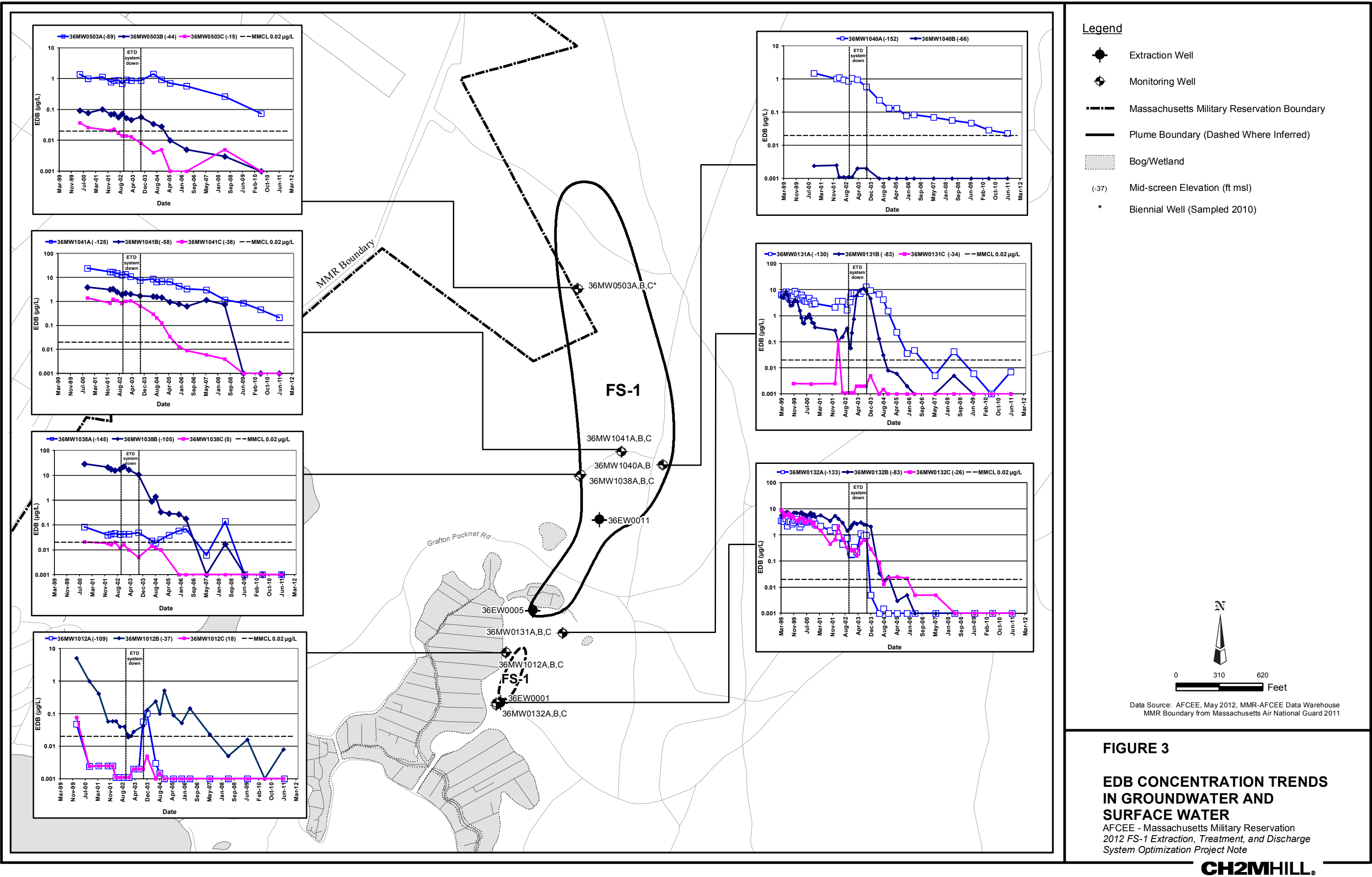
FIGURE 2

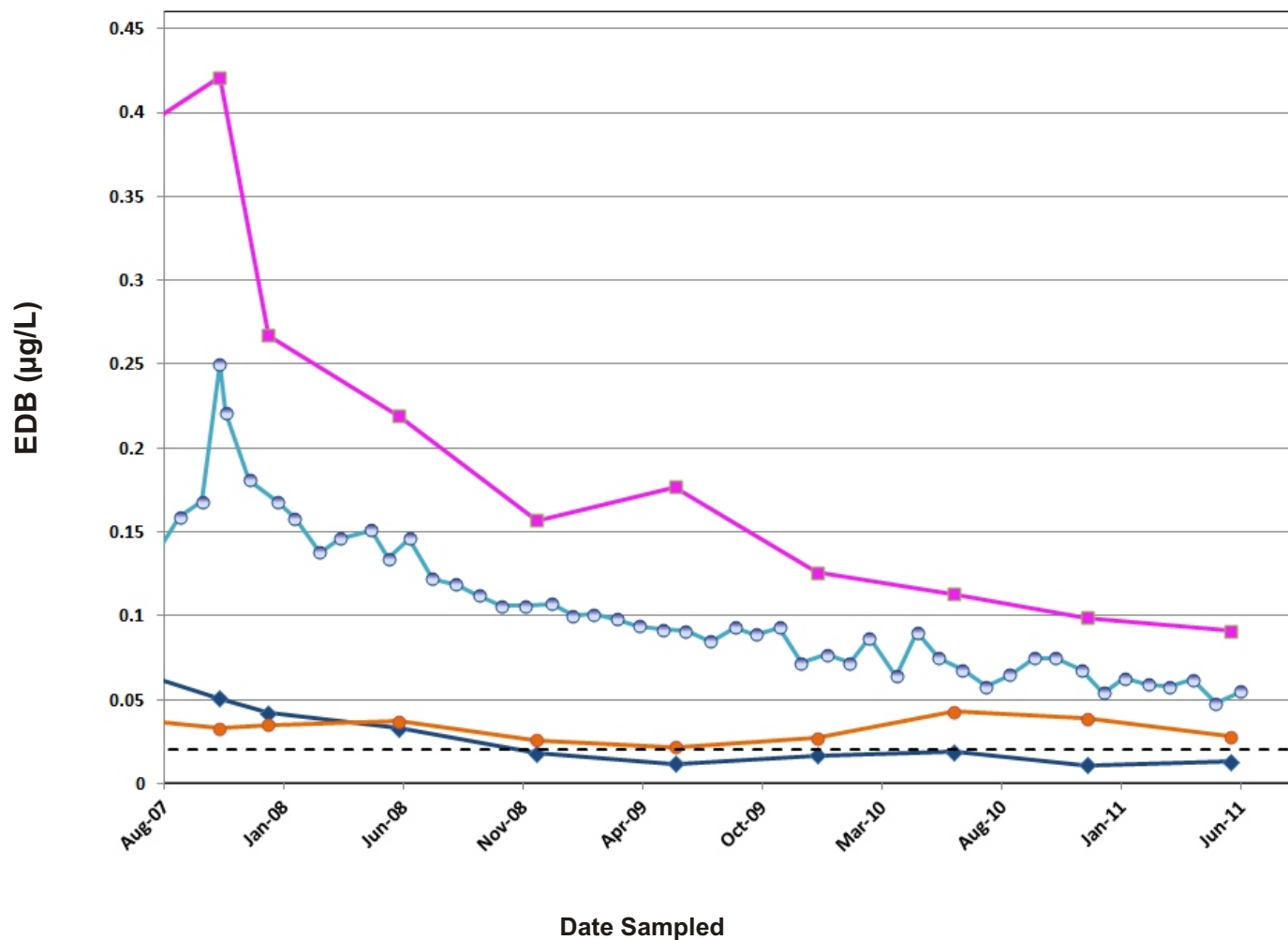
FS-1 2011 ETHYLENE DIBROMIDE  
DETECTIONS IN GROUNDWATER

AFCEE - Massachusetts Military Reservation  
2012 FS-1 Extraction, Treatment, and Discharge  
System Optimization Project Note

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#### Legend

◆ 36EW0001

● 36EW0005

■ 36EW0011

● Plant Influent

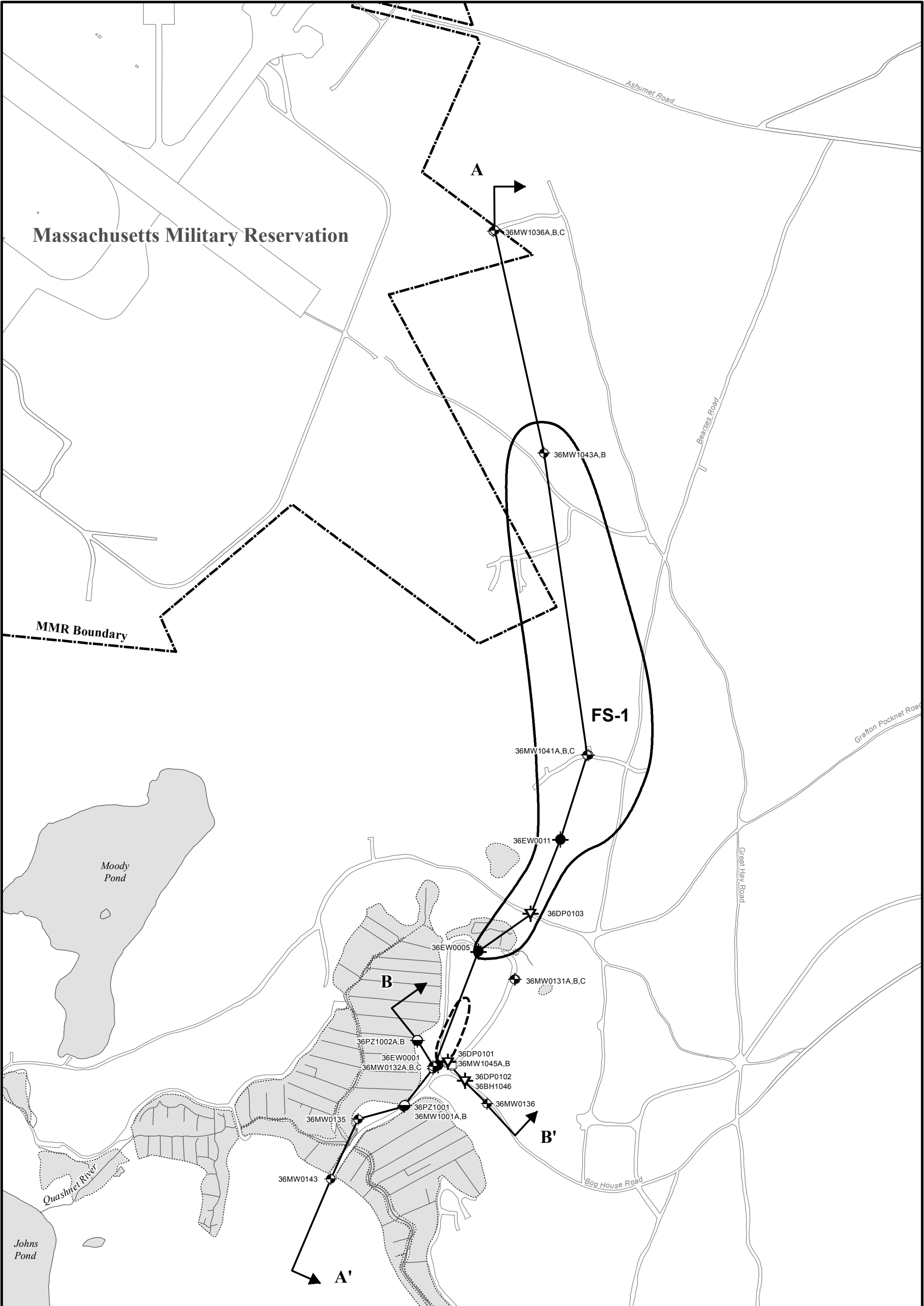
-- MMCL

Data Source: AFCEE, September 2011, MMR-AFCEE Data Warehouse

#### FIGURE 4

#### FS-1 EXTRACTION WELL AND PLANT INFLUENT DATA - 5 YEAR OVERVIEW

AFCEE - Massachusetts Military Reservation  
2012 FS-1 Extraction, Treatment, and Discharge  
System Optimization Project Note



Legend

- Extraction Well
- Monitoring Well
- Piezometer
- Direct Push
- Sonic Locations

- Massachusetts Military Reservation Boundary
- Plume Boundary (Dashed Where Inferred)
- Cross-Section Line
- Bog/Wetland

Data Source: AFCEE, May 2012, MMR-AFCEE Data Warehouse  
MMR Boundary from Massachusetts Air National Guard 2011

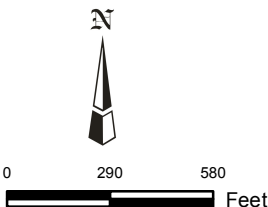


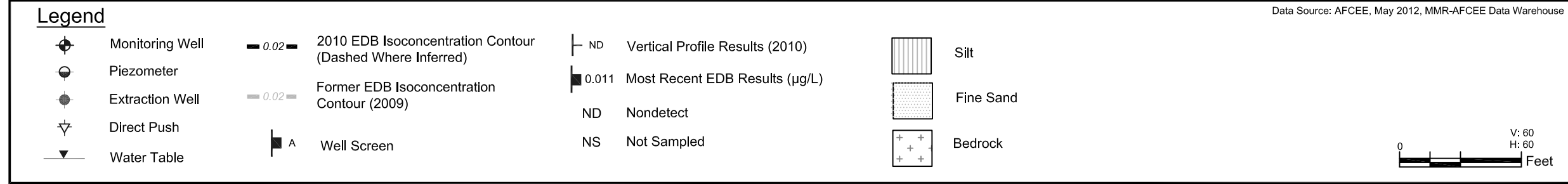
FIGURE 5

FS-1 EDB PLUME AND LOCATION OF CROSS-SECTION LINES

AFCEE - Massachusetts Military Reservation  
2012 FS-1 Extraction, Treatment, and Discharge  
System Optimization Project Note

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AFCEE - Massachusetts Military Reservation  
2012 FS-1 Extraction, Treatment, and Discharge  
System Optimization Project Note






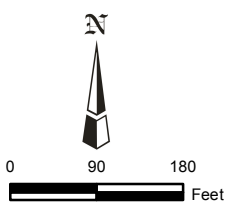


### Legend

-  Monitoring Well
-  Extraction Well
-  Piezometer

-  Plume Boundary  
(Dashed Where Inferred)

Data Source: AFCEE, MMR-AFCEE Data Warehouse.  
2009 Aerial Photography from MassGIS



### FIGURE 7

#### FS-1 36EW0001 AREA

AFCEE - Massachusetts Military Reservation  
2012 FS-1 Extraction, Treatment, and  
Discharge System Optimization Project Note

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**Table 1**  
**FS-1 Treatment System Mass Removal Summary - 2011**  
**2012 FS-1 ETD System Optimization Project Note**

Date	36EW0001		36EW0005		36EW0007 <sup>(3)</sup>		36EW0011		Total EDB Removed (Extraction Well Sampling)		Total EDB Removed (Plant Influent Sampling)	
	Incremental Mass Removed (lbs)	Cumulative Mass Removed (lbs)	Incremental Mass Removed (lbs)	Cumulative Mass Removed (lbs)	Incremental Mass Removed (lbs)	Cumulative Mass Removed (lbs)	Incremental Mass Removed (lbs)	Cumulative Mass Removed (lbs)	Incremental Mass Removed (lbs)	Cumulative Mass Removed (lbs)	Incremental Mass Removed (lbs)	Cumulative Mass Removed (lbs)
Jan-11	0.000	0.803	0.002	1.407	0.000	1.095	0.009	3.832	0.012	7.137	0.011	7.458
Feb-11	0.000	0.803	0.002	1.409	0.000	1.095	0.008	3.840	0.010	7.147	0.010	7.468
Mar-11	0.000	0.803	0.002	1.411	0.000	1.095	0.009	3.848	0.011	7.157	0.011	7.479
Apr-11	0.000	0.804	0.002	1.413	0.000	1.095	0.008	3.857	0.011	7.169	0.011	7.490
May-11	0.000	0.804	0.002	1.415	0.000	1.095	0.009	3.865	0.011	7.179	0.010	7.500
Jun-11	0.000	0.805	0.002	1.417	0.000	1.095	0.008	3.873	0.010	7.190	0.009	7.510
Jul-11	0.000	0.805	0.001	1.418	0.000	1.095	0.007	3.880	0.009	7.198	0.009	7.519
Aug-11	0.000	0.805	0.001	1.420	0.000	1.095	0.006	3.886	0.008	7.206	0.008	7.527
Sep-11	0.001	0.806	0.001	1.421	0.000	1.095	0.006	3.892	0.008	7.214	0.008	7.534
Oct-11	0.000	0.806	0.001	1.422	0.000	1.095	0.005	3.898	0.007	7.221	0.008	7.542
Nov-11	0.000	0.807	0.001	1.423	0.000	1.095	0.004	3.902	0.005	7.227	0.007	7.550
Dec-11	0.000	0.807	0.001	1.423	0.000	1.095	0.004	3.906	0.005	7.231	0.007	7.556

<b>EDB Removed (lbs) by Final ETD System (January 2011 - December 2011)</b>	<b>0.11</b>
<b>EDB Removed (lbs) by Final ETD System since startup (September 2003 - December 2011)<sup>1</sup></b>	<b>7.56</b>
<b>EDB Removed (lbs) by Interim ETD System (April 1999 - October 2002)<sup>2</sup></b>	<b>10.31</b>
<b>Total EDB Mass Removed (lbs) between April 1999 and December 2011</b>	<b>17.87</b>

Data Source: AFCEE, February 2012, MMR-AFCEE Data Warehouse

Notes:

1. Final ETD system began operation on 30 September 2003.
2. Interim ETD system operated between April 1999 and October 2002.
3. 36EW0007 was turned off on 01 October 2007 as part of the ETD system optimization.

Key:

EDB = ethylene dibromide

ETD = extraction, treatment, and discharge

lbs = pounds

**Table 2**  
**EDB Influent Concentrations at 36EW0001 Since 2008**  
**2012 FS-1 ETD System Optimization Project Note**

Location	Date	Analyte	Result	DL	RL	Flow (gpm)	Comments
			All units = µg/L				
36EW0001	6/11/2008	EDB	0.033	0.002	0.01	90	
36EW0001	12/10/2008	EDB	0.018	0.002	0.01	90	
36EW0001	6/10/2009	EDB	0.012	0.003	0.01	90	
36EW0001	12/15/2009	EDB	0.017	0.003	0.01	90	
36EW0001	6/14/2010	EDB	0.019	0.005	0.01	90	
36EW0001	12/6/2010	EDB	0.011	0.005	0.01	90	
36EW0001	6/14/2011	EDB	0.013	0.005	0.01	90	
36EW0001	7/22/2011	EDB	0.018	0.006	0.01	90	Packers installed 11 July 2011
36EW0001	8/1/2011	EDB	0.014	0.005	0.01	90	
36EW0001	11/1/2011	EDB	0.021	0.005	0.01	--	Minimum purge after 1 week rest period
36EW0001	11/9/2011	EDB	ND	0.005	0.01	45	
36EW0001	12/6/2011	EDB	0.009	0.005	0.01	45	
36EW0001	1/26/2012	EDB	0.011	0.005	0.01	45	
36EW0001	4/16/2012	EDB	0.031	0.005	0.01	--	Minimum purge after 1 week rest period

Data Source: AFCEE, April 2012, MMR-AFCEE Data Warehouse and Preliminary Data Reports

-- = Flow rate not applicable. Sample collected after a 1 well volume purge

Key:

DL = detection limit

EDB = ethylene dibromide

ETD = extraction, treatment and discharge

gpm = gallons per minute

ND = nondetect

RL = reporting limit

µg/L = micrograms per liter

**Table 3**  
**FS-1 ETD System Pumping Schedule: Current Design (2007 Scenario 01) and Interim Design (2012 Scenario 01)**  
**2012 FS-1 ETD System Optimization Project Note**

Extraction Well	2007 Scenario 01				2012 Scenario 01			
	Flow Rate (gpm)	Top Screen Elevation (ft msl)	Bottom Screen Elevation (ft msl)	Screen Length (ft)	Flow Rate (gpm)	Top Screen Elevation (ft msl)	Bottom Screen Elevation (ft msl)	Screen Length (ft)
36EW0001 <sup>(1)</sup>	90	-4.90	-129.05	100	0	-103.49	-129.05	26
36EW0005 <sup>(2)</sup>	175	-138.38	-148.38	10	175	-138.38	-148.38	10
36EW0007	0	-97.72	-134.85	30	0	-97.72	-134.85	30
36EW0011 <sup>(3)</sup>	250	-88.66	-150.65	48	250	-88.66	-150.65	48

Data Source: AFCEE, April 2012, MMR-AFCEE Data Warehouse

Notes:

1. The effective screen length of 36EW0001 has been shortened as part of 2012 Scenario 01.
2. The effective screen length of 36EW0005 was shortened as part of 2007 Scenario 01.
3. The screen at 36EW0011 has a blank between -130.73 and -144.56 ft msl.

Key:

ETD = extraction, treatment and discharge

ft = feet

gpm = gallons per minute

msl = mean sea level



# **ATTACHMENT A**

# FS-1 ETD System Optimization

## 26 April 2012 Technical Update Meeting

### **Background**

- Operation of 36EW0001 began in September 2003, with the startup of the final ETD system at FS-1 (Figure 1).
- SPEIM monitoring conducted since 2003 indicates that concentrations of EDB and the FS-1 plume footprint have decreased significantly since system startup; particularly in the area of 36EW0001 (Figures 2 and 3).
  - Most wells south of Grafton Pocknet Road are ND
  - Sub-MMCL detections reported at deepest screens at monitoring well clusters
  - Influent concentrations at 36EW0001 decreased to sub-MMCL (Figure 4)
  - No measurable mass of EDB removed by 36EW0001 in 2011 (Table 1)

# **FS-1 ETD System Optimization**

## **26 April 2012 Technical Update Meeting**

### **Field Data Gap Investigation (Figures 5 and 6)**

- Additional groundwater characterization data are consistent with SPEIM and plant monitoring data
  - Groundwater vertical profiling in 2010 (sub-MMCL detections) deeper in the aquifer

### **Optimization Testing (Table 2)**

- Packers installed in July 2011 to focus extraction stress deeper in the aquifer, where sub-MMCL concentrations of EDB were detected during vertical profiling
  - No increase in influent concentrations
- Collected a minimum purge sample from 36EW0001 after one-week rest period (November 2011)
  - EDB influent concentration of 0.021 µg/L

# **FS-1 ETD System Optimization**

## **26 April 2012 Technical Update Meeting**

### **Optimization Testing (Continued)**

- Reduced flow at 36EW0001 from 90 gpm to 45 gpm in an effort to reduce the width of the capture zone
  - ND and sub-MMCL concentrations reported in influent
- Collected a minimum purge sample after one-week rest period (April 2012)
  - EDB at 0.031 µg/L

### **Conclusions**

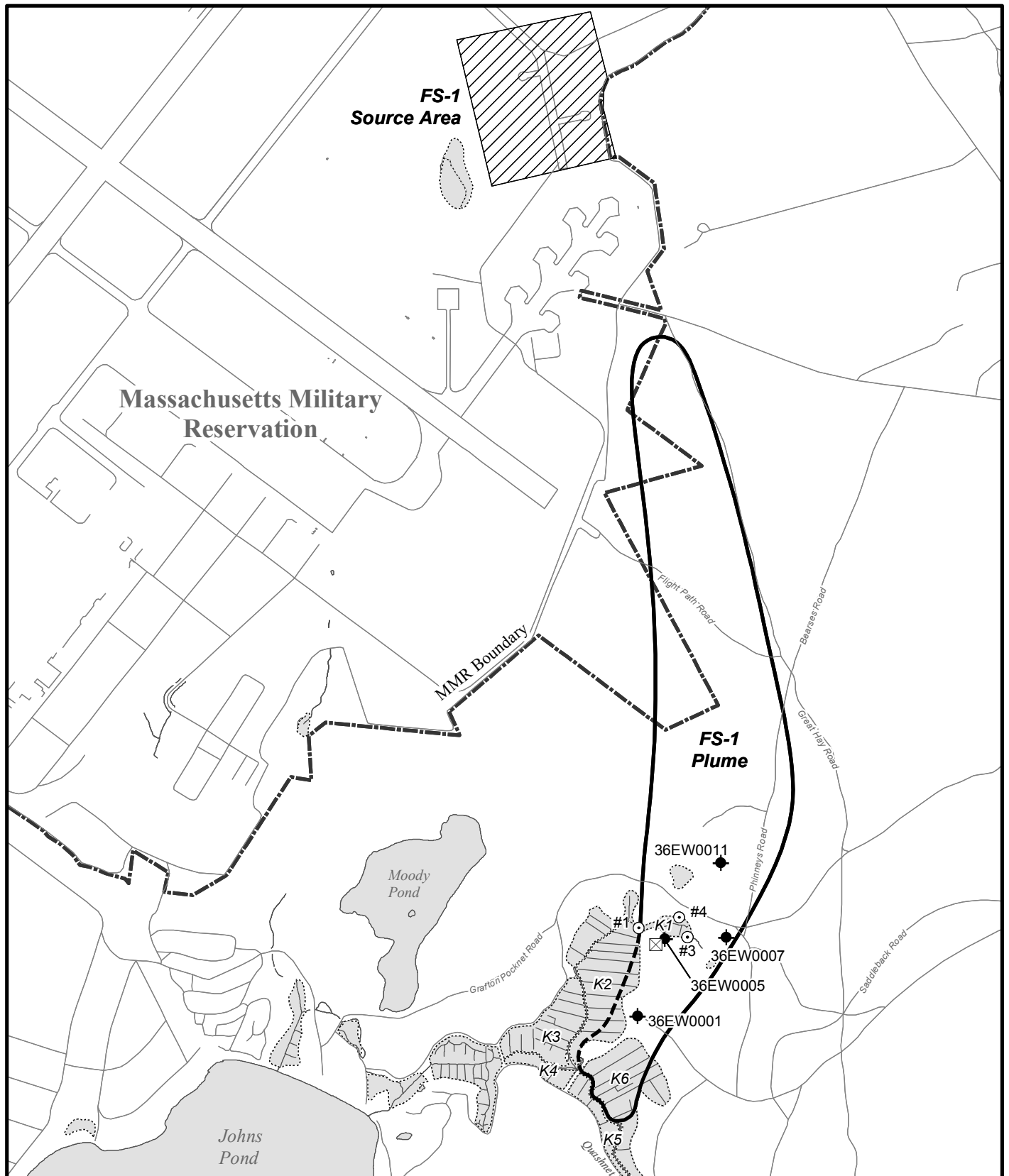
- Optimization sampling at 36EW0001 indicates that a small area of low concentration EDB remains deep in aquifer in the immediate vicinity of this extraction well
- Operation of 36EW0001 at 45 gpm will capture this EDB mass

# **FS-1 ETD System Optimization**

**26 April 2012 Technical Update Meeting**

## **Path Forward**

- Operate the FS-1 ETD system using optimized pumping configuration “2012 Scenario 01” (Table 3)
- Sample 36EW0001 semiannually for SPEIM
- Periodic sampling of 36EW0001 using a minimum-purge after a 1 week rest period. The data will be used to identify future ETD optimization opportunities



### Legend

- |     |  |   |   |
|-----|--|---|---|
| ⊙   | Outflow Bubbler                                | — | Plume Boundary<br>(Dashed Where Inferred) |
| ◆   | Extraction Well                                | ▤ | Bog/Wetland                               |
| ⊠   | Treatment Plant                                | ▨ | Source Area                               |
| --- | Massachusetts Military<br>Reservation Boundary |   |   |

Data Source: AFCEE, January 2005, MMR-AFCEE Data Warehouse  
MMR Boundary from Massachusetts Air National Guard 2011



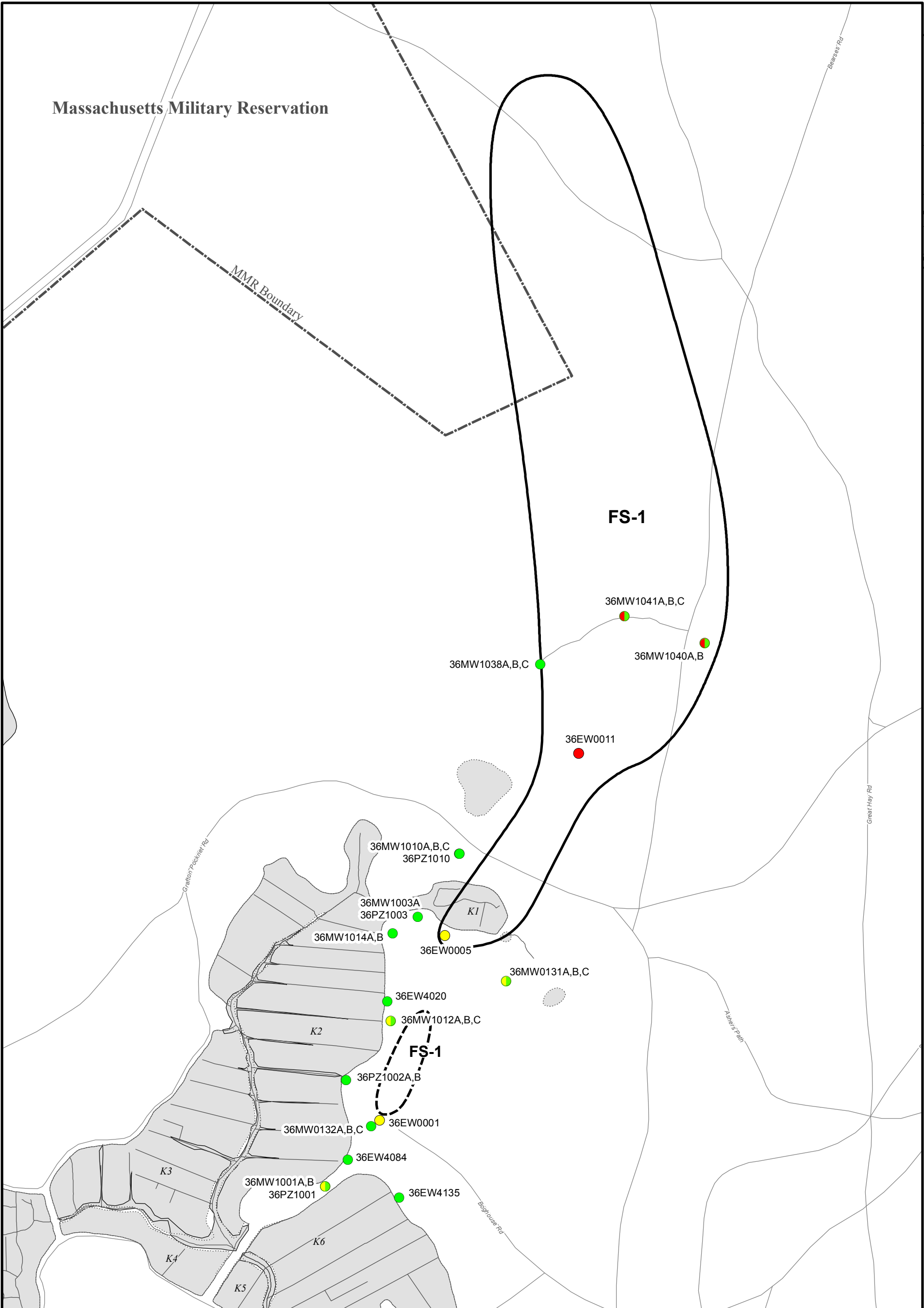
0 600 1,200  
Feet

### FIGURE 1

### FS-1 GROUNDWATER PLUME AND ETD SYSTEM AT SYSTEM STARTUP (2003)

AFCEE - Massachusetts Military Reservation  
26 April 2012 Technical Update Meeting

**CH2MHILL**



Path: X:\Figures\SP\MMR\2012\TechUpdate\Amr26\GIS\amrmap\FS-1\_12AprilTechUp\_Fig02.mxd Date: 4/23/2012 Time: 3:09:10 PM User: 127247091.E

Legend

- Plume Boundary (Dashed Where Inferred)
- Massachusetts Military Reservation Boundary
- Bog/Wetland

Contaminant Detections:

- No Detection
- Detection Below or at MMCL
- Detection Above MMCL

Data Source: AFCEE, February 2012, MMR-AFCEE Data Warehouse  
MMR Boundary from Massachusetts Air National Guard 2011

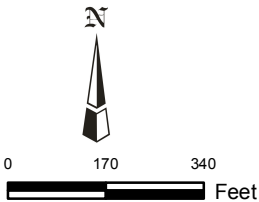


FIGURE 2

FS-1 2011 ETHYLENE DIBROMIDE  
DETECTIONS IN GROUNDWATER

AFCEE - Massachusetts Military Reservation  
26 April 2012 Technical Update Meeting

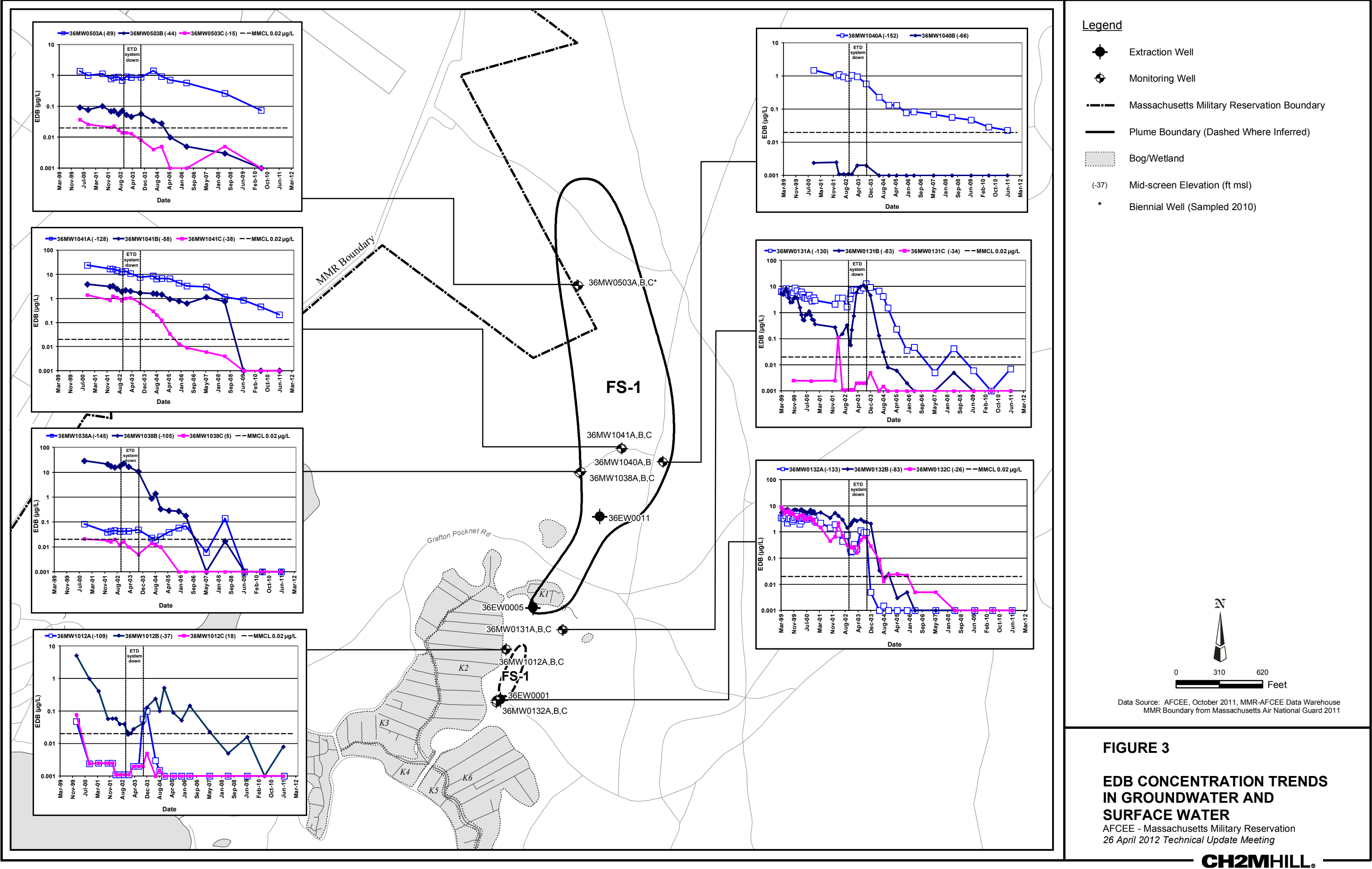
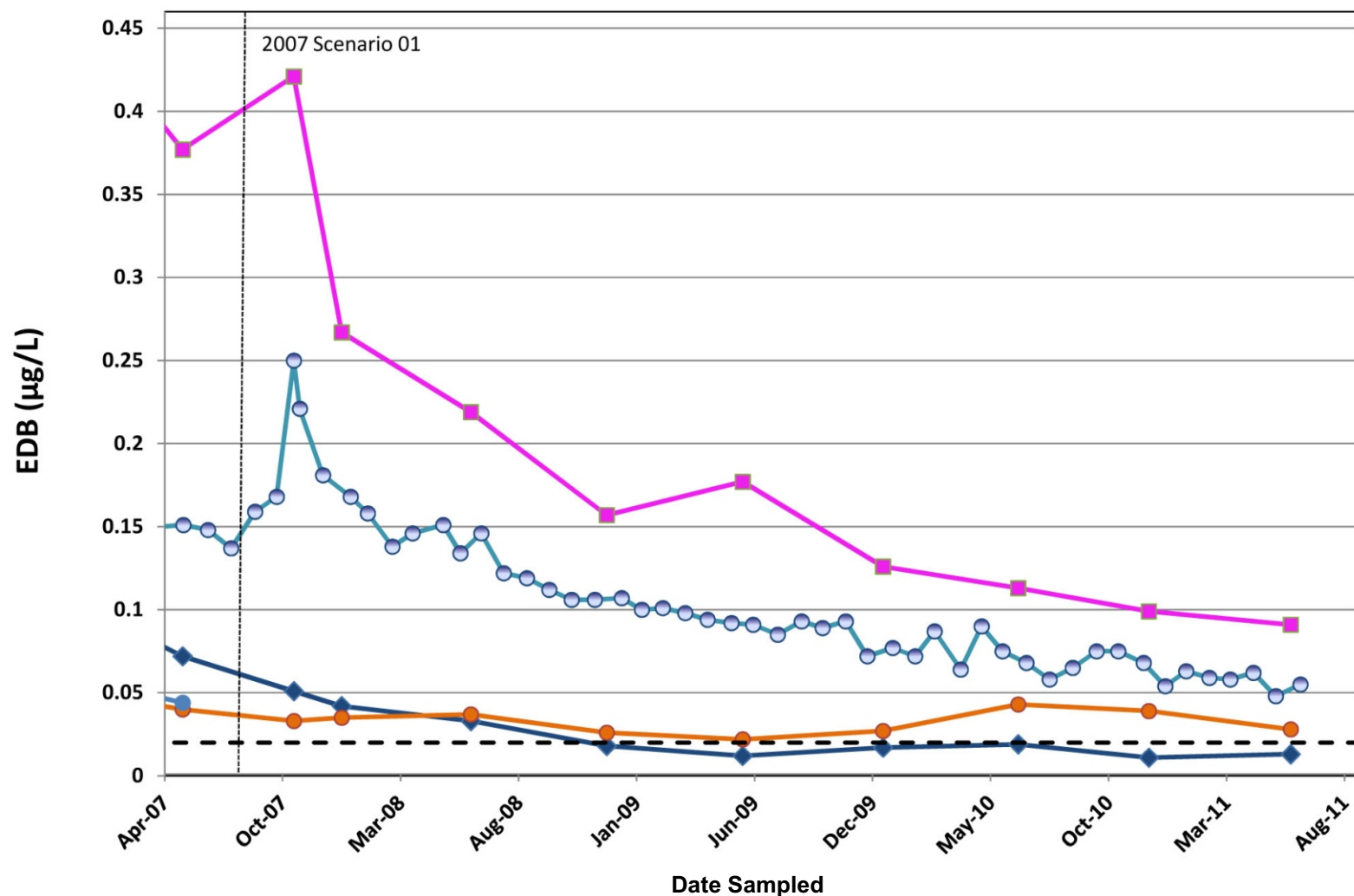


FIGURE 3

**EDB CONCENTRATION TRENDS  
IN GROUNDWATER AND  
SURFACE WATER**

AFCEE - Massachusetts Military Reservation  
26 April 2012 Technical Update Meeting





#### Legend

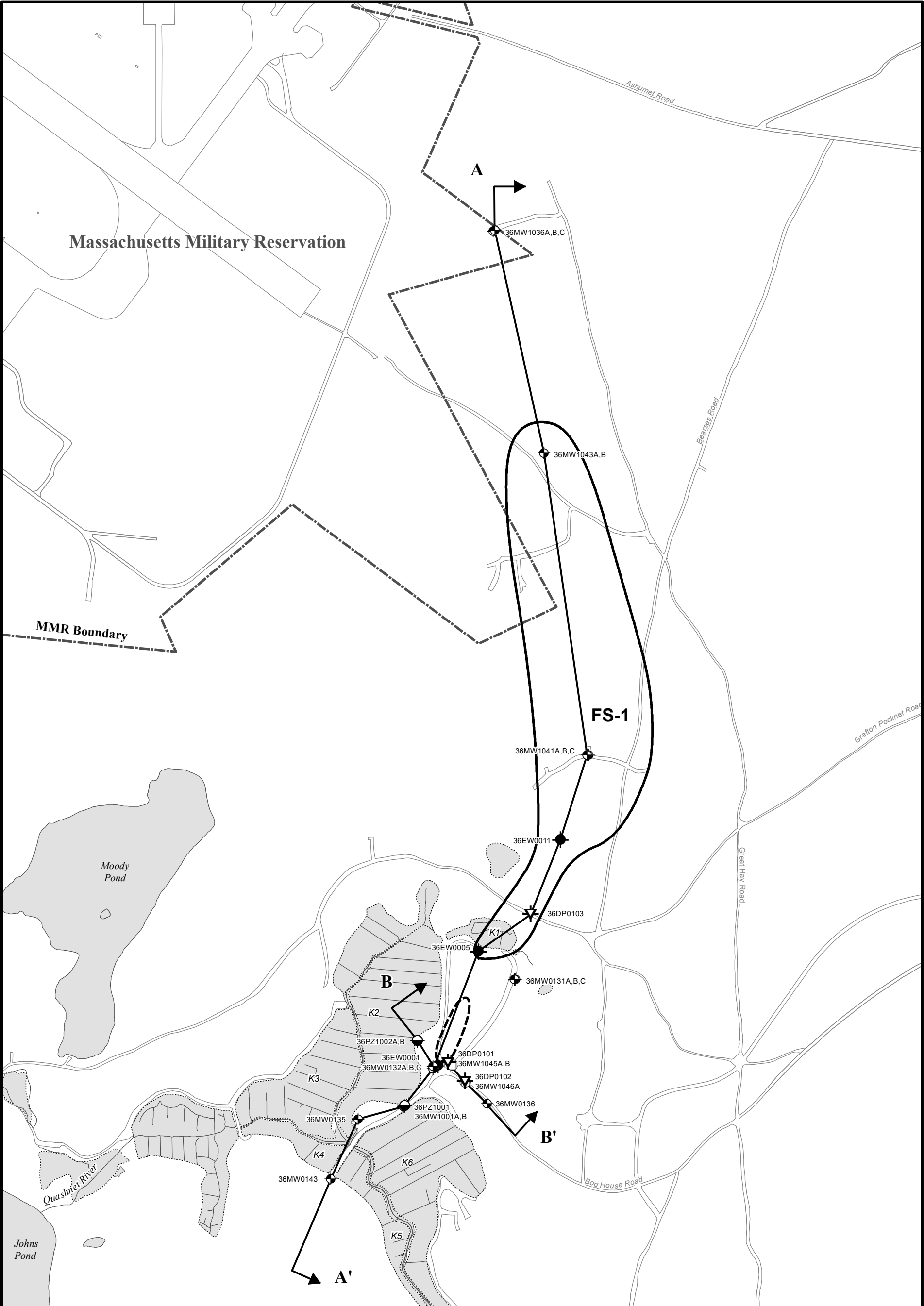


Data Source: AFCEE, September 2011, MMR-AFCEE Data Warehouse

#### FIGURE 4

#### FS-1 EXTRACTION WELL AND PLANT INFLUENT DATA - 5 YEAR OVERVIEW

AFCEE - Massachusetts Military Reservation  
26 April 2012 Technical Update Meeting



**Legend**

Extraction Well

Monitoring Well

Piezometer

Direct Push

Sonic Locations

Massachusetts Military Reservation Boundary

Plume Boundary (Dashed Where Inferred)

Cross-Section Line

Bog/Wetland

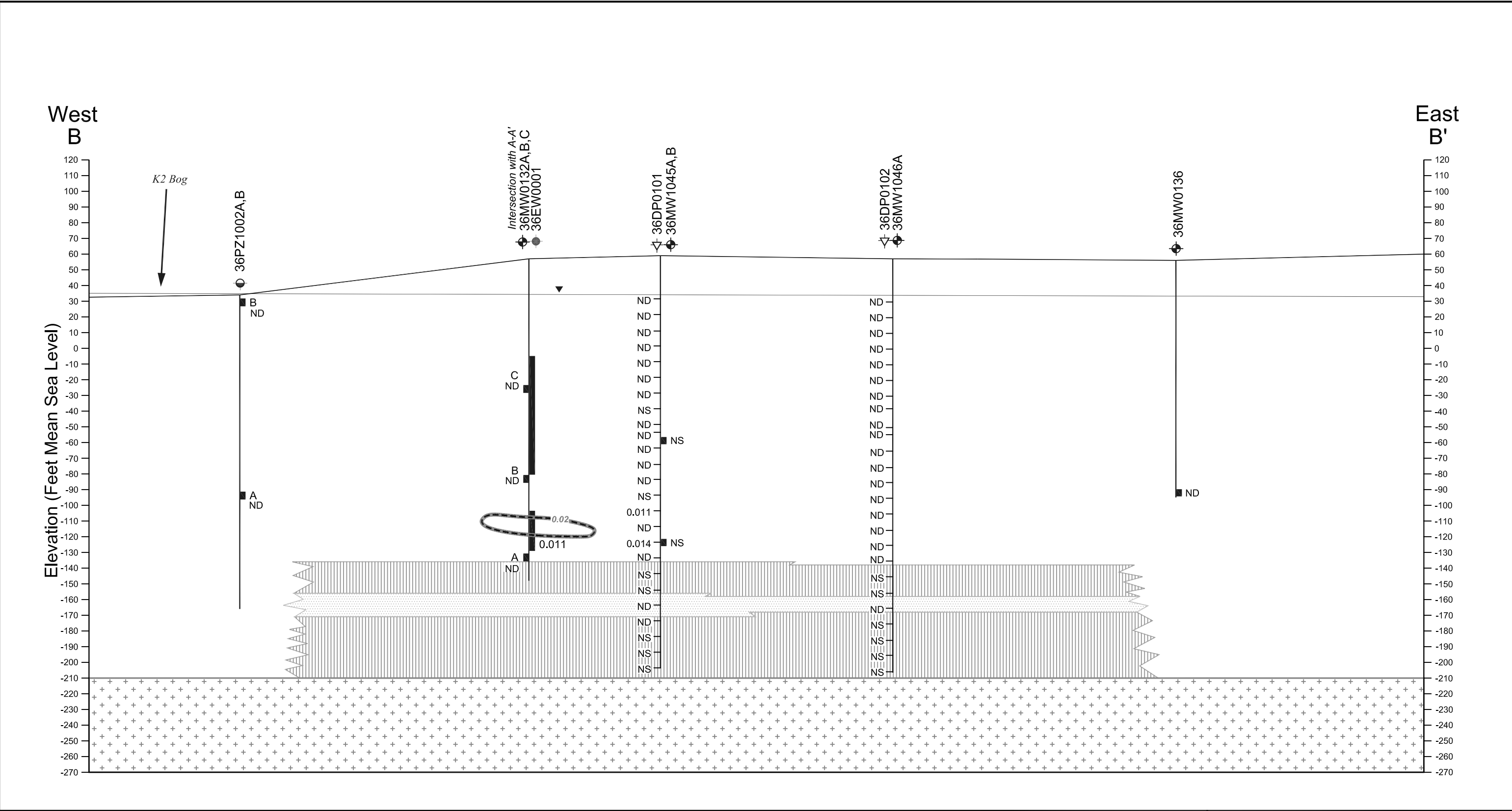
Data Source: AFCEE, April 2012, MMR-AFCEE Data Warehouse  
MMR Boundary from Massachusetts Air National Guard 2011

0 290 580 Feet

**FIGURE 5**

**FS-1 EDB PLUME AND LOCATION OF CROSS-SECTION LINES**

AFCEE - Massachusetts Military Reservation  
26 April 2012 Technical Update Meeting

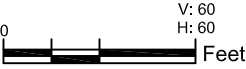


Legend

- |  |                 |  |   |  |                                      |  |           |
|--|-----------------|--|---|--|--------------------------------------|--|-----------|
|  | Monitoring Well |  | 2010 EDB Isoconcentration Contour (Dashed Where Inferred) |  | ND Vertical Profile Results (2010)   |  | Silt      |
|  | Piezometer      |  | Former EDB Isoconcentration Contour (2009)                |  | 0.011 Most Recent EDB Results (µg/L) |  | Fine Sand |
|  | Extraction Well |  | A Well Screen   |  | ND Nondetect                         |  | Bedrock   |
|  | Direct Push     |  |   |  | NS Not Sampled                       |  |           |
|  | Water Table     |  |   |  |                                      |  |           |

Data Source: February 2011, AFCEE, MMR-AFCEE Data Warehouse

**FIGURE 6**  
**FS-1 CROSS-SECTION B-B'**  
AFCEE - Massachusetts Military Reservation  
26 April 2012 Technical Update Meeting



**Table 1**  
**FS-1 Treatment System Mass Removal Summary - 2011**  
**26 April 2012 Technical Update Meeting**

Date	36EW0001		36EW0005		36EW0007 <sup>(3)</sup>		36EW0011		Total EDB Removed (Extraction Well Sampling)		Total EDB Removed (Plant Influent Sampling)	
	Incremental Mass Removed (lbs)	Cumulative Mass Removed (lbs)	Incremental Mass Removed (lbs)	Cumulative Mass Removed (lbs)	Incremental Mass Removed (lbs)	Cumulative Mass Removed (lbs)	Incremental Mass Removed (lbs)	Cumulative Mass Removed (lbs)	Incremental Mass Removed (lbs)	Cumulative Mass Removed (lbs)	Incremental Mass Removed (lbs)	Cumulative Mass Removed (lbs)
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<b>EDB Removed (lbs) by Final ETD System (January 2011 - December 2011)</b>	<b>0.11</b>
<b>EDB Removed (lbs) by Final ETD System since startup (September 2003 - December 2011) <sup>1</sup></b>	<b>7.56</b>
<b>EDB Removed (lbs) by Interim ETD System (April 1999 - October 2002) <sup>2</sup></b>	<b>10.31</b>
<b>Total EDB Mass Removed (lbs) between April 1999 and December 2011</b>	<b>17.87</b>

Data Source: AFCEE, February 2012, MMR-AFCEE Data Warehouse

Notes:

1. Final ETD system began operation on 30 September 2003.
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3. 36EW0007 was turned off on 01 October 2007 as part of the ETD system optimization.

Key:

ETD = extraction, treatment, and discharge

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**Table 2**  
**EDB Influent Concentrations at 36EW0001 Since 2008**  
**26 April Technical Update Meeting**

Location	Date	Analyte	Result	DL	RL	Flow (gpm)	Comments
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36EW0001	7/22/2011	EDB	0.018	0.006	0.01	90	Packers installed 11 July 2011
36EW0001	8/1/2011	EDB	0.014	0.005	0.01	90	
36EW0001	11/1/2011	EDB	0.021	0.005	0.01	--	Minimum purge after 1 week rest period
36EW0001	11/9/2011	EDB	ND	0.005	0.01	45	
36EW0001	12/6/2011	EDB	0.009	0.005	0.01	45	
36EW0001	1/26/2012	EDB	0.011	0.005	0.01	45	
36EW0001	4/16/2012	EDB	0.031*	0.005	0.01	--	Minimum purge after 1 week rest period

Data Source: AFCEE, April 2012, MMR-AFCEE Data Warehouse and Preliminary Data Reports

\* = result is preliminary and unvalidated

-- = Flow rate not applicable. Sample collected after a 1 well volume purge

Key:

DL = detection limit

EDB = ethylene dibromide

gpm = gallons per minute

µg/L = micrograms per liter

ND = nondetect

RL = reporting limit

**Table 3**  
**FS-1 ETD System Pumping Schedule: Current Design (2007 Scenario 01) and Optimized Design (2012 Scenario 01)**  
**26 April 2012 Technical Update Meeting**

Extraction Well	2007 Scenario 01				2012 Scenario 01			
	Flow Rate (gpm)	Top Screen Elevation (ft msl)	Bottom Screen Elevation (ft msl)	Screen Length (ft)	Flow Rate (gpm)	Top Screen Elevation (ft msl)	Bottom Screen Elevation (ft msl)	Screen Length (ft)
36EW0001 <sup>(1)</sup>	90	-4.90	-129.05	100	45	-103.49	-129.05	26
36EW0005 <sup>(2)</sup>	175	-138.38	-148.38	10	175	-138.38	-148.38	10
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36EW0011 <sup>(3)</sup>	250	-88.66	-150.65	48	250	-88.66	-150.65	48

Data Source: AFCEE, April 2012, MMR-AFCEE Data Warehouse

Notes:

1. The effective screen length of 36EW0001 has been shortened as part of 2012 Scenario 01.
2. The effective screen length of 36EW0005 was shortened as part of 2007 Scenario 01.
3. The screen at 36EW0011 has a blank between -130.73 and -144.56 ft msl.

Key:

ft = feet

gpm = gallons per minute

msl = mean sea level